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Editorial

CARCINOMA OF THE BREAST

A COMMENT ON THERAPY

CARCINOMA of the breast is one of the most common forms of malignant disease in women. In spite of improved diagnostic and therapeutic measures it remains a major medical problem.

In reviewing our cases over a ten-year period at one of the municipal hospitals we found that only one-half of the women admitted for definitive therapy were considered operable. The reason for this is that the diagnosis in these cases was not made early. The better results being obtained today must surely be attributed to earlier diagnosis (let us say when the disease is still in its "benign" stage) and not to the type of therapeutic procedure performed. Since the local lymph glands are involved early, the "benign" stage would be considered to be that period when the disease process is still definitely limited to the local tumor area yet within the confines of the breast tissue.

Surely many of us have seen cases with long-term survivals in which excisional biopsies were done originally for a malignant lesion and were followed with radical mastectomies, and in which detailed microscopic examination of the specimen did not reveal the presence of any malignant disease. It is quite likely that in such instances local excision alone may have effected a cure and that certainly a simple mastectomy would have eradicated all diseased tissue. The latter would therefore seem to have been an effective procedure for those cases. Here one cannot escape the conviction that the very early diagnosis would definitely be the reason for the gratifying results.

There is such a difference of opinion in the literature today that it is difficult to judge the best method for treating operable cancer of the breast. The most widely accepted procedure is the so-called radical mastectomy. But what *is* the radical operation? A review of the literature does not yield the answer to this question. Indeed, Halstead himself was confused as to what really constituted the operation bearing his name. At one time Halstead did not remove all of the pectoralis minor; at another he removed the supraclavicular nodes; still later he removed a part of the chest wall. In 1907 he advised stripping the fascia from the upper part of the rectus abdominus and the serratus anterior. In 1913 Halstead stated that he had discontinued the incision out on the arm and advised instead a vertical incision extending upward toward the clavicle.

Today, although the procedure appears to be standardized, there is still a considerable amount of confusion which leaves one with no specific method to follow. The principles for the procedure of radical mastectomy are still as stated by Halstead; however, even these principles are questioned in current literature so that we read of one group of surgeons who question the validity of wide skin excision and still others who advise excision wide enough to require skin grafting. In fact, the general trend is even toward more extensive surgery for cure and palliation.

We are all acquainted with the lymphatic spread of cancer of the breast, and you will recall that the disease can and does extend up

into the base of the neck and also into the sulcus along the high mediastinum. If we are to be consistent in our radicalism, we should dissect supraclavicular nodes in all cases, dissect components of the brachial plexus, do low neck dissection and perhaps attempt some form of mediastinal exploration as suggested by Gordon-Taylor. Would this then assure us of a cure? How can one be certain that the process has not extended beyond *these* regions? Knowing the great variation in the rate of growth of breast cancer and the difficulty of judging the results, the doubt cannot be easily dispelled that extremely radical surgery may produce needless disability and suffering.

It appears to me that the aim of the surgeon should be not only to attempt to cure the patient but also, principally, to prolong life and make her physically and mentally comfortable. It is no compromise to use discrimination in selecting the extent of treatment necessary to relieve or cure. Needless mutilation is little less than criminal whereas mutilation which would assure us of a cure might be justifiable even though the hazard might be great. However, at present we have no method that assures a cure.

One of the puzzles of the problem of cancer of the breast is why we fail to obtain a 100 per cent cure of patients with a localized lesion in the absence of axillary node involvement. It must mean that there is already an extension of disease beyond the site of lymph node removal. It is curious that some of these patients have a recurrence after many years of apparent cure, some as late as thirty years after operation. Again, it must be stressed that we are never assured of cure even in the face of the most honest, aggressive and radical approach in combating this disease.

McWhirter has aroused considerable interest —and no little controversy—by recommending simple mastectomy to be followed with x-ray therapy. His idea is that if the axilla is not involved there is no need for axillary dissection; and if the axillary nodes *are* involved, removal of this natural barrier together with the operative trauma may well cause dissemination of cancer cells to distant sites. His views are so contrary to the teachings in this country that everyone hesitates even to consider adoption of this course of treatment without further proof that it is a procedure of choice. I am, however, inclined to be in sympathy with his line of thought and believe that we should maintain an open mind until we can definitely prove that his procedure is not adequate and for the best interest of the patient.

The value of roentgen therapy has also aroused much controversy. The efficacy of postoperative radiation must also be considered with an open mind and, indeed, favorably when one realizes that postoperative recurrences have been reduced and that survival rates have been increased by as much as 10 per cent. Since radiotherapy is a method of choice in many other forms of cancer, it must be considered that this treatment can also destroy or at least inhibit the progress in the growth of cancer cells of the breast.

Physicians generally agree that inoperable cases should be treated with irradiation. They recognize that palliation received through such treatment is usually beneficial and often amazingly effective. If good results are obtained with inoperable cases, there appears to be some inconsistency in the reasoning that irradiation will not benefit the patient after operation. This inconsistency becomes more apparent when one bears in mind that cells spreading beyond the operative field may be rapidly growing and anaplastic, therefore more radiosensitive. Although uniform positive statistical proof of benefit may be lacking, the knowledge that cancer cells are destroyed or devitalized by irradiation justifies such treatment.

In general, I agree with McWhirter; however, there are two points that we have stressed in our procedure of the extended type of simple mastectomy in some of our cases which are worthy of noting. First, I believe that axillary dissection should be continued because cancer as a rule metastasizes into the base of the axilla and removal of involved nodes might be beneficial for the following two reasons: (1) The disease may be limited to only those nodes involved. (2) In addition to the removal of the primary focus of the disease with simple mastectomy we may be removing a lesion in the involved nodes which might otherwise continue to act as a primary focus for further dissemination of the disease. If the nodes prove to be hyperplastic, the removal will do no harm. As for the dissemination of malignant cells following operative trauma, immediate postoperative irradiation will be sufficiently effective to inhibit the progress of any disseminated cells and, if the patient should develop distant

metastases, it would be only because these probably were in the process of formation at the time of operation. It is also my belief that the fascia overlying the pectoralis major and the surrounding fascia should be removed because of its intimate relationship to the lymphatic system of both the breast and axilla. Handly says, "Unfortunately the microscopic growing edge of the carcinoma is not clinically recognizable, and the surgeon cannot determine for each case as it comes before him how far the circle of fascial permeation has extended."

Since there are no satisfactory clinical means of fixing the limit of fascial extension, the only safe rule would be to remove a very wide area of the deep fascia; this is an innocuous procedure and it would probably be beneficial. If the tumor is fixed to muscle, the muscle should be removed with the breast. However, any surgical procedure beyond that, it appears to me, would be futile.

The extended simple mastectomy and adequate postoperative irradiation strikes me as most suitable in cases of stages I and II. Stages III and IV will, of course, have a low rate of survival with any form of therapy; but if the condition of the patient warrants any surgical intervention at all, she should at least have the benefit of a simple mastectomy followed with x-ray.

We are aware of the fact that several factors influence the prognosis such as the age of the patient, location of the tumor, and histopathologic findings; however, the postoperative mortality and morbidity is definitely decreased following such simple procedures. The operative wound heals more quickly and x-ray therapy can accordingly be applied without delay.

It must be admitted that not enough time has elapsed nor are there sufficiently well controlled cases to justify definite conclusions. Nevertheless the statistics presented by McWhirter are most encouraging and they indicate to me that these simple procedures must have some merit. Final judgment concerning the true value of this form of therapy must be reserved for the future; however, it is only by maintaining an open mind that we can succeed in combating this disease, accepting the risks which are the inevitable concomitant of all real human progress.

THOMAS C. CASE, M.D.

Original Articles

THE HINDQUARTER (INTERINNOMINO-ABDOMINAL) AMPUTATION*

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ONE of the most arresting features about surgery in recent years is the magnitude of the operative procedures which have been carried out successfully in all regions of the body. Not least among these procedures is the hindquarter or interinnomino-abdominal amputation, an operation which until a few years ago claimed a mortality of some 60 to 70 per cent. Performed first unsuccessfully by Billroth in 1891, according to Berg,[2] it remained for Girard[5] a few years later to prove the feasibility of this procedure. That any surgeon was able to do so at that time is nothing short of astounding when one considers that anesthesia was still in the rag and bottle stage, asepsis was unknown, any blood transfusion which had been attempted up to that time had always resulted in the death of the recipient and intravenous therapy was as yet unthought of. In other words the surgeon had at his disposal none of the supportive measures since developed with which to combat either infection or hemorrhage and its bedfellow, shock, all of which factors exacted a heavy toll of lives in that surgical era. Thus we must pay tribute to Girard's courage and skill which enabled him to be the first to demonstrate that the performance of this formidable operation need not entail the death of the patient.

The literature on the subject of this amputation reveals some encouraging facts. In the first place, within recent years there has been a striking reduction in the mortality rate. Secondly, the number of cases reported has increased in a short space of time to such an extent that as many of these amputations have been performed in the last seven or eight years as were done in the preceding fifty, with the result that many patients to whom this operation would have been previously denied found themselves able to obtain the relief which it alone could bring. The writer considers that this salutary state of affairs is in no small measure due to the interest aroused in the operation by the writings of the British surgeon, Sir Gordon Gordon-Taylor, who by 1946 had to his credit the outstanding feat of having performed no less than twenty-one of these operations, more than one-tenth of the entire number of cases reported in the literature up to the present time.†

During the first two or three decades following Billroth's performance of this amputation the number of reported cases increased slowly. For example, Keen and Da Costa[9] in 1904 when reporting a case gathered from the literature a total of only nineteen cases of which five patients recovered from the operation. When Ransohoff[19] published his case in 1909, he found the number of reported cases had increased to thirty-four. This number consisted of

† In a communication to the author by Sir Gordon Gordon-Taylor in January, 1950, he mentioned that he has now performed forty-two hindquarter amputations.

* From The Division of Surgery, Sansum Clinic, Santa Barbara, Calif.

twenty-four for sarcoma and ten for tuberculosis although most of the amputations for the latter were done in two stages, a disarticulation at the hip joint preceding the removal of part or all of the innominate bone. The mortality was 70 per cent in both types of cases. In 1916 Hogarth Pringle[18] was able to report forty-three of these amputations of which five were his own, the mortality rate having been reduced to 58.1 per cent. By 1934 the number of cases in which this amputation had been performed had reached a total of eighty-four as compiled by Gordon-Taylor and Wiles,[6] this figure including five personal cases of Gordon-Taylor's. The mortality rate was still above 50 per cent. The next landmark in the history of this amputation was an article by Gordon-Taylor[7] in 1940 recording the fact that since his previous communication with Wiles he had performed six more of these amputations. Between the reporting of Ransohoff's case in 1909 and the year 1940 it would appear that not a single case in which the hindquarter amputation was performed was reported by American writers, indicating the lack of interest in this amputation shown on this side of the Atlantic during this period; their lively participation in the literature on the subject during the past few years is probably due to interest in this procedure reawakened by this account of Gordon-Taylor's persistent and successful efforts to alleviate the lot of those individuals with malignant disease so situated that its removal can be accomplished only by this mutilating operation. Leighton[11] in 1942 collected the reported cases to find that the total number had reached 108 with the mortality rate still in the neighborhood of 50 per cent although Leighton himself was reporting three personal cases without any mortality. This article was soon followed by that of Morton[12] reporting four cases without a death and that of King and Steelquist[10] reporting six cases with but a single death. These communications are important because they mark the beginning of victory over the high mortality rates prevalent up to that time. In his latest contribution with Patey in 1946 Gordon-Taylor[8] brings to light such a number of cases which apparently has not been published in the literature that the total number performed exceeds measurably those estimated by various recent writers as, for example, Beck and Bickel[1] who in 1948 stated that approximately 130 cases have been reported in the literature since Billroth's case. The list compiled by Gordon-Taylor and Patey consists of seventy-three cases under the heading of "Details of Interinnominoabdominal Amputation Recorded in the Literature or Known to the Authors since 1935" at which time the total had reached eighty-four; thus these two figures represent a combined total of 157. Since the aforementioned list was compiled, six additional cases have been reported by Sugarbaker and Ackerman,[21] eight by Pack, Ehrlich and Gentil,[15] twelve by Beck and Bickel[1] (including the first two cases published from the Mayo Clinic by Ghormley, Henderson and Lipscomb[4] and listed by Gordon-Taylor and Patey[8]) and three from South America of which two were done by Plate[16] and one by Oliveras-Guerra.[13] These together with the case about to be reported bring the total of recorded cases up to 185. Among the recently reported cases the most impressive is the series of Beck and Bickel consisting as it does of twelve consecutive amputations without a single death. Judging from those cases published recently the present mortality rate can be said to be in the region of 15 per cent, a figure in marked contrast to the 50 per cent of only ten years or so ago. Moreover, since this amputation must now be regarded as a permanent addition to the ever-growing list of surgical procedures, we can anticipate still further lowering of the mortality rate for increasing familiarity with the operation will lead to wider recognition of its hazards and, therefore, to the steps which should be taken to

circumvent them from the standpoints of preoperative preparation, operative technic and postoperative care. As the fact of its increasing availability for suitable cases becomes more widely known to the general practitioner who will usually be the first to be consulted by the patient, suitable cases will reach the surgeon sooner; and so that delay will be avoided which not only reduces the patient's chances of surviving the operation but jeopardizes his ultimate prognosis. Further, the recent increase in the number of these amputations gives one reason to think that in time past many patients, probably suitable candidates for this operation, must have been seen who were allowed to die without benefit of surgery either because the condition was held to be inoperable or the risk of operation was considered too great by the surgeon in whose hands lay the final decision as to treatment. That day is coming to an end and the time is arriving when both general and orthopedic surgeons of experience will be expected to be prepared to undertake this amputation whenever the indications for its performance are present, thus to give assurance that it will not be withheld from any patient whose only chance of survival lies in its performance.

The indications for the performance of this amputation as now established are more or less restricted to tumor formation, benign or malignant, involving either the innominate bone itself or the tissues of the upper thigh, bony, soft or articular, to such an extent that a disarticulation through the hip joint obviously could not be expected to result in complete ablation of the disease. Only one recent amputation was performed for a condition other than tumor, namely, that reported by Christmann and Cingano[3] in a case of hydatid disease affecting the right innominate bone and upper end of femur. The success of the conservative treatment in tuberculosis has banished involvement of the hip joint or innominate bone by that disease as an indication for the hindquarter amputation.

In view of the increase in the number of successful performances of this amputation within recent years and the publication by several surgeons of multiple cases dealt with by this operation, the writer feels somewhat diffident in reporting a single and his only case. He believes, however, that still few enough of these amputations have been done to allow for observations and impressions by one who has attempted to do and has successfully completed this procedure to be of interest and perhaps of some help, especially to any surgeon who like the writer finds himself called upon to undertake his first hindquarter amputation without the benefit of having seen the operation performed. Moreover, the fact that this circumstance has obtained in so many instances in which the outcome was successful should give encouragement to any experienced surgeon who finds himself faced with such a situation.

The technic of the hindquarter amputation has now become reasonably well standardized and the description given hereafter of the operation as performed in the present case represents an account of a technic which would fall under this category. However, some differences of opinion are always likely to exist concerning certain points of technic. Further, the surgeon must be prepared to modify any particular phase of the operation according to circumstances dictated by such considerations as variations in the site, type and extent of the tumor, the conservation of blood supply to retained structures, difficulties attending the control of hemorrhage, etc. The more important of these controversial points and modifications will later be indicated and discussed in some detail.

CASE REPORT

I. E. P., a sixty-four year old farmer, entered the Santa Barbara Cottage Hospital on December 22, 1947, complaining of a swelling and discharge in the region of the right groin and weakness and numbness of the right leg. In

1A 1B

FIG. 1. Photographs showing swelling with central sinus in right groin from (A) medial and (B) lateral aspects.

January, 1947, when pulling a hayfork forcibly from the loft he struck himself in the right groin with the handle. The blow was so severe that he thought he had broken a bone. For two weeks he hobbled about and then experienced a sharp, lancinating pain along the outer side of the right thigh for which he sought relief by chiropractic treatment. A few days later he consulted a physician who made the diagnosis of rheumatic arthritis and prescribed diathermy treatment. In August, 1947, he first noticed a small, hard lump in the right groin. This lump enlarged slowly over a period of two or three weeks when he again consulted his physician who advised that a biopsy be taken. This was done and the report was made of chronic, inflammatory tissue. X-ray films of the pelvis taken at this time were reported as negative. The wound did not heal but continued to discharge and he was then sent for deep x-ray therapy, taking treatments three times weekly for four weeks. During this time the swelling had ceased to pain but the drainage became profuse and foul. Along with the swelling and discharge his right leg became weak and somewhat numb; and because he found difficulty in walking, he began using crutches. Although his appetite remained good, his weight had been reduced from 150 pounds to less than 130 during the past few months.

His past history was essentially negative except that he had been a heavy smoker for many years.

Physical examination revealed a fairly well developed white male of the wiry type appearing to be about sixty years old. The head, neck, thorax and abdominal examinations were essentially negative. In the right groin below Poupart's ligament was a swelling, hard and slightly tender to palpation, measuring about 6 by 8 cm. and elevated some 3 cm. above the level of the skin. (Fig. 1A and B.) In the center of this mass was a discharging sinus, the discharge being thin and purulent and having a fetid odor. The surface was smooth and the edge was ill defined, shelving into the surrounding tissues. The base was fixed. The femoral artery was displaced superficially and laterally by the mass. There was noticeable atrophy of the right leg.

The laboratory reported the urinalysis to be negative. The blood count showed a hemoglobin of 75 per cent with 4,000,000 red blood cells, 8,700 white blood cells, 63 per cent polymorphonuclears, 30 per cent lymphocytes, 4 per cent monocytes, 2 per cent basophiles and 1 per cent eosinophiles. The sedimentation rate was 93 mm. in one hour. The Kahn and Kline tests were both negative. The electrocardiogram showed left axis deviation, coronary insufficiency and ventricular extrasystoles. The skin test for coccidioidosis was negative after forty-eight hours. Culture from the discharge showed a hemolytic staphylococcus aureus; no acid-fast organisms were seen. A culture was made for Bacillus tuberculosis but this eventually proved to be negative. The alkaline phosphatase was 6.7 King and Armstrong units. X-ray of the chest was reported negative. The only abnormality seen in the x-rays of the dorsal and lumbar spines was an old compression fracture of the seventh dorsal vertebra.

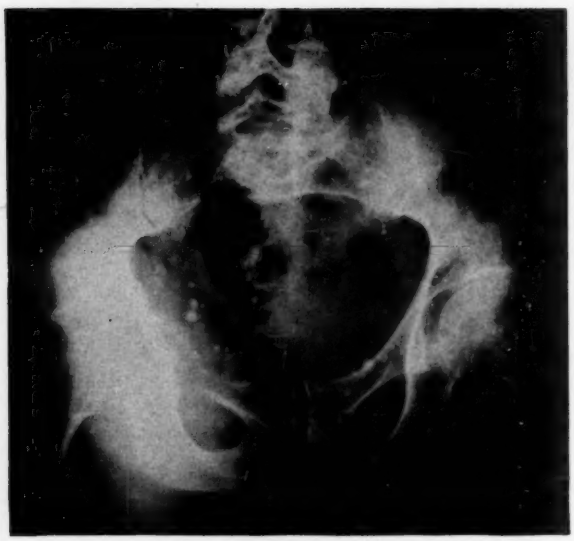


FIG. 2. X-ray film of pelvis before operation showing destructive process involving the right superior pubic ramus and pelvic portion of the acetabulum.

Roentgenographic studies of the pelvis showed a destructive process involving the ascending pubic ramus and the pelvic portion of the acetabulum on the right side. (Fig. 2.) Dr. M J. Geyman expressed the opinion that low grade, non-specific, chronic inflammation, malignant tumor of bone and tuberculosis were the lesions to be considered in the differential diagnosis.

In order to establish the diagnosis the sinus was explored under anesthesia on December 29th. It was lined by whitish, firm material suggestive of sarcoma and opened into a cavity some 5 cm. in diameter and containing foul, purulent material. Some of this material together with cancellous bony tissue from the wall of the cavity was removed by curettage for pathologic examination. The pathologic report was "moderately rapidly growing chondrosarcoma."

In view of this diagnosis the lack of evidence of metastasis, clinical or roentgenologic, and the fact that deep x-ray therapy had been given with no apparent beneficial result, a hindquarter amputation was advised as the only possible treatment that held any prospect of cure or relief.

This operation was performed on January 8, 1948, under sodium pentothal, nitrous oxide and cyclopropane anesthesia. With the patient arranged between the lateral and supine positions by elevating the right side and buttock with sand bags, the anterior portion of the operation was carried out. The incision was begun posterior to the anterosuperior iliac spine and continued medially just above and parallel to Poupart's ligament curving the medial half upward in a semi-circular manner so as to avoid cutting through the infiltrated skin surrounding the draining sinus and then downward to end on the upper and medial aspect of the thigh. (Fig. 3*b*.) The lateral attachment of Poupart's ligament was separated from the bone and the medial attachment similarly dealt with, care being taken to avoid damage to the spermatic cord which was retracted medially. The external iliac artery was divided between ligatures distal to the origin of the deep circumflex iliac and epigastric branches. Before division of the corresponding vein at the same level the limb was held up for several minutes to empty it of as much blood as possible. Both artery and vein were separated from the underlying tumor without difficulty. The femoral nerve was pulled downward, injected with 1 per cent procaine and divided. The suspensory ligament of the penis was then cut through and the large, deep dorsal vein of the penis seen passing backward under the symphysis. The attachment of the rectus muscle to the upper surface of the pubic bone was then divided and the region of the symphysis denuded. The symphysis was then divided by a Gigli saw, retracting the bladder and prostate on the one hand and taking care to avoid damage to the deep dorsal vein of the penis on the other, and done without separating the crus and ischiocavernosus penis from the lower border of the inferior pubic ramus. The patient was then turned readily into a true lateral position and the incision was prolonged backward to the posterosuperior iliac spine and the muscles attached to the crest of the ilium divided just above and parallel to the bone. From near the termination of this incision the posterior flap was outlined by another curving downward and forward in front of the greater trochanter and then sweeping backward about 3 inches below it to the gluteal fold along which it was extended medially to meet the lower end of the anterior incision. (Fig. 3*c*.) The aponeurosis over the anterior border of the gluteus maximus muscle was then incised and the muscle retracted posteriorly to form part of the posterior flap. The deep structures of the gluteal region now came into view. The deep branches of the superior gluteal artery were located and divided

between ligatures as were the inferior gluteal and internal pudendal arteries. The superficial branches of the superior gluteal artery were preserved. The great sciatic notch was defined, a Gigli saw introduced through it and the dorsum ilii divided upward, care being taken to protect the superior gluteal artery from injury. The separated innominate bone was then drawn away from the pelvis and the remaining structures passing out of the pelvis through the sciatic notch were divided, the sciatic nerve being injected with procaine and ligatured before its division. The levator ani muscle and the sacrospinous and sacrotuberous ligaments were divided and the separation of the innominate bone finally completed by detaching the crus penis and ischiocavernosus muscle from the inferior pubic ramus.

After hemostasis had been effected, two tissue drains were laid down in the extraperitoneal space and brought out through the opposite angles of the wound. The aponeurosis of the gluteus maximus was sutured to Poupart's ligament and the skin edges apposed by interrupted dermal sutures. (Fig. 4.) A Foley catheter was inserted into the bladder and the patient returned to his room.

During the operation, which lasted nearly four hours, the patient was transfused with 2,000 cc. of blood and his good condition was consistently maintained; his blood pressure was 120/80 mm. Hg. when he was removed from the operating table.

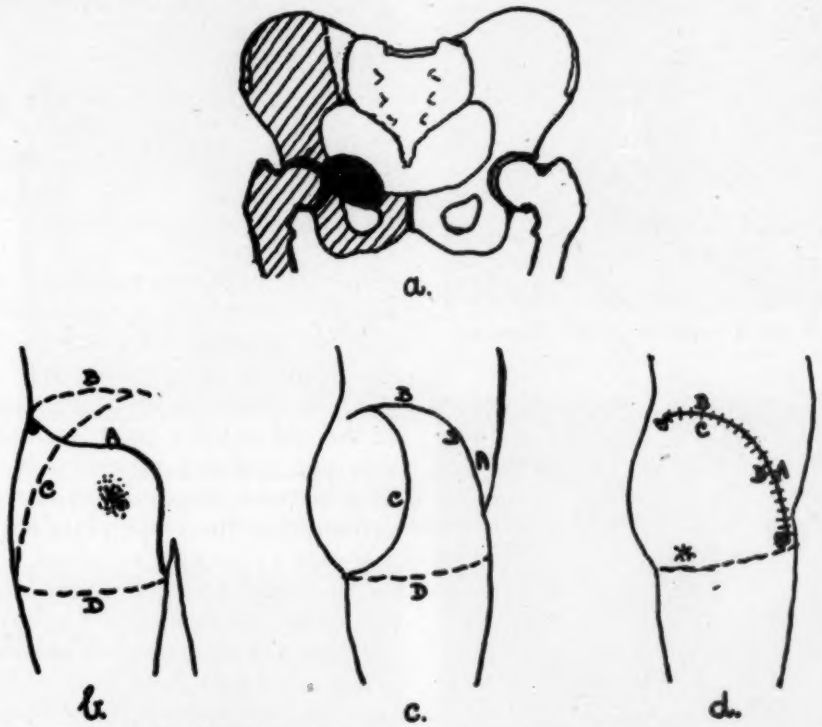


FIG. 3. Diagram by author showing (*a*) site and size of tumor and amount of bone removed (shaded), incision from (*b*) anterior and (*c*) lateral aspect, and (*d*) wound closure.

The pathologist's comment on his detailed pathologic examination was that the previous diagnosis indicated that this was a chondrosarcoma. As was seen in the sections the tumor was growing principally as a neoplasm, producing cartilage cells. When the entire mass of tumor was available for study, there were various other types of growths found in the tumor, namely, that of osteoid tissue, cartilage and fibrous tissue. (Fig. 5.) It is for this reason that a diagnosis of osteogenic sarcoma was made rather than that of a tumor with the various component types. The prognosis must necessarily be guarded since these tumors frequently metastasize by way of the blood stream. It is interesting that the lymph nodes which were recovered did not contain any tumor.

During the first twenty-four hours postoperatively the patient was given 1,000 cc. of blood. Penicillin, 50,000 units every four

FIG. 4. Photograph of wound at completion of amputation.

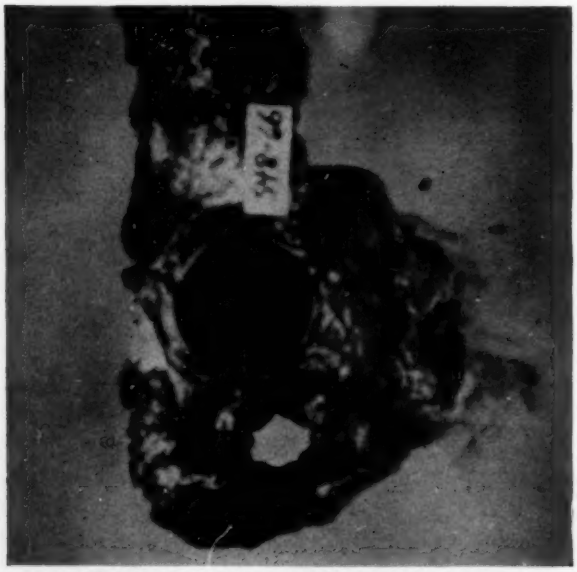


FIG. 5. Photograph of denuded innominate bone showing tumor of superior pubic ramus.

hours, was begun again and continued for a week.

The only complication which arose and which gave rise to some anxiety was an atelectasis of the lower lobe of the left lung. This, however, was dealt with quickly and successfully. On the third postoperative day the patient was sitting on the side of the bed and on the fourth he was standing by the side of his bed and also sitting on a chair. On the sixth day he was trying out his crutches. On the fourth day both tissue drains were shortened and on the eighth day they were removed. Alternate dermal sutures were removed on the

FIG. 6. Photograph of wound completely healed taken on fourteenth postoperative day.

fifth day and the remainder on the tenth. Figure 6 shows the wound healed completely. The patient was fitted with a suitable support for his pelvis. (Fig. 7A and B.)

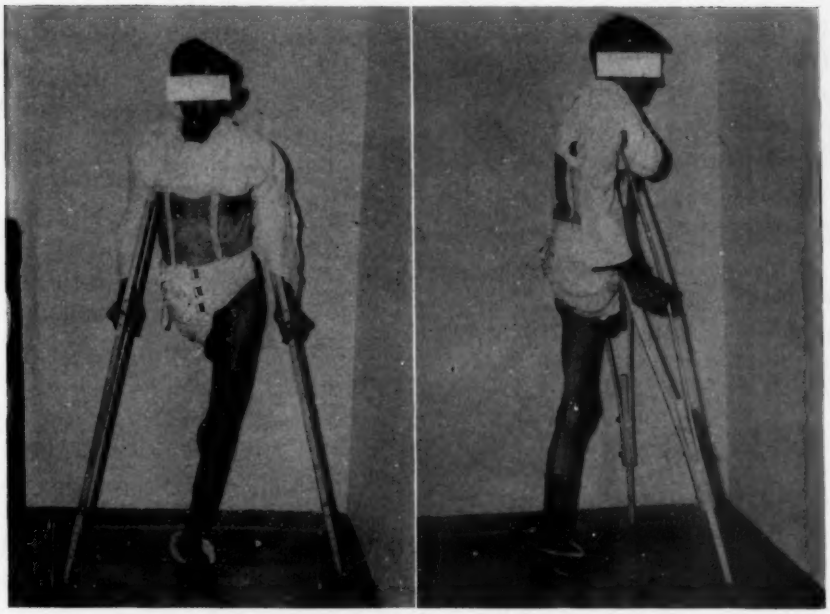
There was some leakage around the catheter at the end of forty-eight hours; and because it was not draining properly, it was removed. The patient began to void well but was catheterized for residual urine the next day and only 15 cc. were obtained. From that time on the patient had no difficulty voiding and the urine remained clear.

In spite of the fact that before operation the patient had complained somewhat of constipation, no trouble with the bowels arose. No evacuation was permitted until the fifth day in order to avoid the possibility of any contamination of the wound. Once they began to move there was no indication that the expulsive and sphincter mechanisms were in any way affected by the operation.

The patient was discharged from the hospital on January 26, 1948, the sixteenth postoperative day.

At the time of his discharge from the hospital the patient was requested to return for examination in about six weeks. This he did on March 3rd. He felt and looked well; he had a good appetite, was not troubled by any indigestion and his bowels and urinary tract both had functioned as well as before his operation.

The blood count showed 81 per cent hemoglobin, 4,330,000 red cells and 6,500 white cells. An x-ray of the pelvis showed the absence of any destructive process in the remaining portion. (Fig. 8.) There were no signs of local recurrence. X-ray of the chest showed parenchymal infiltration into the right lung from the hilus and pleural parenchymal density in



7A 7B

FIG. 7. Photographs showing (A) front and (B) side views of pelvic support provided. This consisted essentially of an abdominal belt with attached adjustable padded canvas support and shoulder straps.

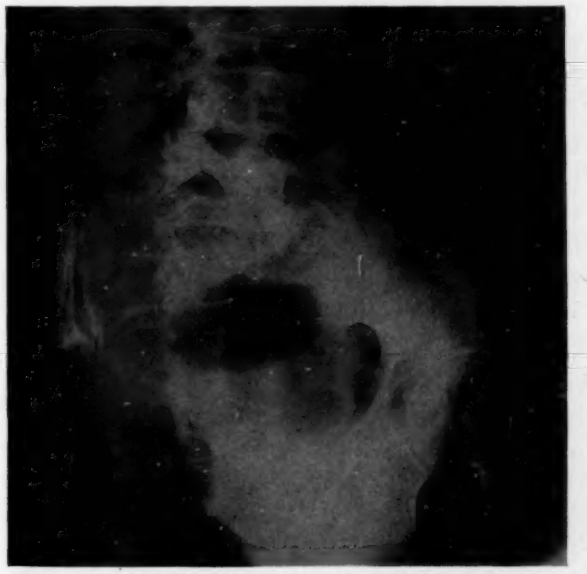


FIG. 8. X-ray film of pelvis taken eight weeks after operation; no signs of destructive process in remaining portion.

FIG. 9. X-ray film of chest taken eight weeks after operation showing metastatic involvement of both lungs.

the lower portion of the left lung. (Fig. 9.) These changes were considered to indicate the presence of pulmonary metastatic sarcoma. Up to this time he had not developed any cough, expectoration, thoracic pain or other clinical symptoms usually associated with secondary involvement of the lung by malignant disease. However, shortly after he had returned home these symptoms manifested themselves and the patient died in a month, having survived the operation only three months or so, a surgical disappointment which will be the subject of further comment.

COMMENTS

It is the purpose of this commentary to review and make some attempt to evaluate the more important practical points concerned in dealing with a patient on whom a hindquarter amputation is to be performed, using the present case as a basis for discussion.

Preoperative Considerations. The first step to be taken is to establish the diagnosis. In spite of whatever help the x-ray film may give when bone is involved, it is essential in any case to know the diagnosis in terms of cytology in order that a decision can be made by consultation between pathologist, radiologist and surgeon as to the role, if any, to be played by deep x-ray therapy in the treatment of the patient. This necessitates a biopsy to provide tumor tissue for microscopic examination. In the present case this form of therapy had already been given without beneficial effect so that there was no point in considering its further employment.

In a case in which a pathologic lesion is present in such a situation that no procedure less than a hindquarter amputation could successfully remove it, two conditions must be fulfilled before this operation is advised. The first is that the lesion, so far as can be ascertained on clinical or roentgenologic grounds, has not already spread locally beyond the bounds of operative removal; second, that there is no evidence, roentgenologic or clinical, of metastasis having taken place as, for example, in the lungs or other bones. Any case fulfilling these conditions can be regarded as a suitable one for this amputation from a local standpoint but at once the necessity arises of considering the patient's general condition in relation to the magnitude of the contemplated surgical assault to which he is about to be subjected. The first thing to be done, therefore, is to find out if any definite contraindications to the performance of the operation are present, which step entails the investigation of the patient's several systems by an experienced internist. Should none be found the type of measures with which the patient should be fortified in the hope and expectation of diminishing the operative risk and thereby increasing his chances of successfully withstanding the operation remains to be decided.

Among such measures the more important are blood transfusions, intravenous alimentation, the exhibition of vitamins, especially the B complex and C and perhaps K, and a high vitamin, high caloric, low residue diet. Naturally the choice of any or all of these measures and the extent to which each is used will vary in the individual case according to the needs of the patient and should be regulated by judgment based on present day practice. All these measures were used in preparing the present patient for operation.

Since according to the reports in the literature postoperative wound infection appears to be not uncommon, a sulfa compound (sulfadiazine was used in the present case) should be given a sufficient number of days in advance to ensure a satisfactory blood level on the day of operation; also, penicillin should be given in doses of 40,000 to 50,000 units every four hours for the forty-eight hours immediately preceding the operation. With regard to the more immediate preoperative preparations of the patient for surgery, this need not differ materially from that used for any major operation insofar as attention to the bowels and medications are concerned. The bladder should be catheterized just before the patient is taken to the operating room. The catheter may be left in place, in which case a Foley type should be used, or may be removed and replaced after the operation according to the wish of the surgeon.

Once the patient is on the operating table the position in which he is to be placed comes up for consideration. Much has been written about the danger of rotating the patient from the supine to the lateral position in cases in which a spinal anesthetic is being used. A compromise which not only

minimizes such a danger but which is more convenient from the surgeon's standpoint can be readily effected by starting the operation with the patient supported between the lateral and supine positions by sandbags placed under the back and buttocks as was done in the present case. This position not only is easily maintained but also offers no hindrance to the anterior dissection. On completion of this part of the amputation so little rotation of the patient is necessary in order to proceed with the posterior dissection that no time is lost; it is doubtful if any harm could befall a patient under these circumstances even if he is under the influence of a spinal anesthetic. In the present case with the patient under a general anesthetic no disturbances of pulse, respiration or blood pressure were noted when he was turned into the lateral position.

In the draping of the patient for operation an important point to be considered is the exclusion of the anus. Gordon-Taylor has mentioned the "impertinent intrusion" of this part of the anatomy into the operative field and he now seals off the orifice by means of a piece of cellophane or green protective retained in position by means of sutures. Pack and Ehrlich go a step further and close it with a purse-string suture of silk. Both these methods of dealing with this orifice will prove satisfactory although in the present case it was sealed off by the more simple and, as it proved, very successful expedient of attaching a wound towel with carefully applied clamps to the perianal skin.

Anesthesia. Among surgeons there will always be "great argument about it and about" on the question of the use of spinal versus general anesthesia in major surgical procedures when either type may be administered; the hindquarter amputation offers yet another basis for such discussion. This, however, we believe would not be of much help for the literature contains accounts of the successful use of each type and it is obvious that the anesthetist will wish to give the type of anesthesia which he believes will produce the best results in his hands.

Gordon-Taylor has always been a proponent of spinal anesthesia although he persistently warns about the care which must be taken when rotating the patient (a consideration of little or no moment when general anesthesia is used) and is supported in this country by Sugarbaker and Ackerman. On the other hand, Pack and Ehrlich, who believe that this form of anesthesia is not the one of choice in any surgical procedure when a marked drop of blood pressure might occur, prefer the use of general anesthesia for this amputation.

A general anesthetic consisting of induction with sodium pentothal followed with nitrous oxide and cyclopropane was given in the present case, and during the whole of the operation which lasted nearly four hours the systolic blood pressure varied only between 110 and 120 mm. Hg and the diastolic between 75 and 90 mm. Hg, the patient leaving the table with a blood pressure of 120/80. This performance was impressive enough to make the writer believe that a skillfully administered general anesthetic is highly satisfactory for this amputation.

Length of Operation. The time taken for the operation in the present case was more than double the length of that reported on occasions by other surgeons. Many of these amputations have been done in less than an hour and a half although not a few of such patients at the end of the operation were reported as having been in a condition which obviously left much to be desired. Although an operating time of nearly four hours may seem excessive, it should be stated that lack of previous acquaintance with the operation led to extreme care in the performance of each step so that although time was no doubt consumed, we believe it was well spent for there were no episodes of serious blood loss and the operation progressed smoothly throughout. Although one realizes that

speed in operating can be a great asset, the excellent result obtained in this case, from the operative standpoint, has convinced the writer that with the patient in the hands of a skilled anesthetist and a plentiful supply of blood available for transfusion, the exercise of due care is of much greater importance than that of speed as an essential of success in the performance of this amputation.

Incision and Flaps. The incision has more or less become standardized but certain points leave room for some discussion. A flap or flaps of some sort are necessary to insure closure of the large wound without tension. The use of a large medial flap as devised first by Savariaud[20] was soon found to be unsatisfactory as there is little chance of its survival unless the obturator artery is preserved to furnish its blood supply. This in turn cannot be done except at the expense of leaving behind the body and most of the rami of the pubic bone. Such a procedure in most cases, especially in those in which the innominate bone itself is involved, would result in the performance of an inadequate amputation. The incision used in the present case, utilizing a large posterior flap after the method of Pringle,[17] is of the type which has been used in most reported cases and has proved exceedingly satisfactory. (Fig. 3*c*.) It is realized that certain modifications may have to be made depending upon the position and extent of the growth. In the present case the medial portion of the anterior incision was made with a large convexity upward in an effort to avoid cutting through skin which might have been infiltrated with tumor cells. (Fig. 3*b*.) Although this maneuver resulted in considerable shortening of the anterior flap, the generous size of the posterior flap allowed the wound to be closed satisfactorily without tension.

A question still debated is the advisability of retaining the gluteus maximus muscle as was done in this case. Actually there seems little to be said in favor of doing so other than that it provides an added amount of padding under the posterior flap. It was thought once that the increased thickness of this flap resulting from the retention of the muscle would help to reduce the possibility of herniation of the unsupported abdominal viscera on the affected side. However, enough patients on whom it was removed have failed to develop herniations as to give satisfactory proof that its removal will not necessarily nor even probably be followed by this complication. In support of its removal as part of the technic of the hindquarter amputation are two important considerations. The first has to do with the question of its involvement by the disease for which the amputation is being undertaken. While obvious involvement would leave one in no doubt as to the course to be followed, the possibility of its microscopic invasion by tumor cells will remain in some cases. The second concerns the viability of this muscle, the blood supply of which is derived from the superior gluteal artery through its superficial branches. If the muscle is to be retained, the greatest care must be taken to insure that no harm befalls its blood supply as otherwise there is reason to believe that this large muscular mass will not survive. In one of the cases reported by Ghormley et al. in which the muscle was retained as part of the posterior flap after injury to the superior gluteal artery had been followed by the ligation of this artery as a hemostatic measure, massive necrosis of the muscle occurred, with accompanying suppuration. We consider, therefore, that a reasonable attitude toward the removal or retention of the gluteus maximus would be to conclude that the muscle must be removed if it is already actually involved by the disease for which the amputation is being done, that it should be removed if any possible doubt about its involvement exists in the mind of the surgeon or if its blood supply has been damaged in any way, and that it may be removed with impunity in any case.

In view of the aforementioned considerations the writer believes that in any future case of hindquarter amputation he may be called upon to perform he would prefer to remove this muscle.

Control of Hemorrhage and Shock. Because of the large blood vessels encountered in this amputation hemorrhage, if and when it occurs, may be of such a serious nature that in the course of a few minutes the condition of the patient may pass from satisfactory to critical. In this way an operation proceeding smoothly and showing every promise of being successful suddenly becomes transformed into a desperate struggle for the patient's life. The most certain way of avoiding such a catastrophe lies in the prophylaxis which can result only from knowledge on the part of the surgeon of those steps in the amputation when hemorrhage is most likely to occur thus enabling him to approach each with due care.

In the first place, the writer would like to call attention to an important possible source of hemorrhage which has been given little notice in the literature. Passing posteriorly under the arcuate pubic ligament and in very close proximity to it is the deep dorsal vein of the penis which comes into view after division of the suspensory ligament of this organ. This vein is very thin walled and may be of surprisingly large caliber as for instance in the present case in which it was about the diameter of an 18 F catheter. Injury to it by lack of gentleness or by the Gigli saw or knife used to divide the symphysis can readily occur if great care is not exercised and will result in profuse hemorrhage since this short vein drains into the pudendal plexus which in turn communicates freely with the adjacent prostatic and vesical plexuses. Further, it is important to realize that damage to this vein is most likely to occur behind the symphysis, that is, in a place where at this stage of the operation the vein is not visible, thus increasing the difficulties of effecting hemostasis. It is true that since hemorrhage from this source is venous, packing may control it temporarily; but this method of hemostasis cannot be regarded as very satisfactory since subsequent manipulations, undertaken before the bleeding point can be exposed and dealt with under direct vision, may result in displacement of the pack sufficiently to permit a recurrence of the hemorrhage on perhaps more than one occasion. Since the symphysis pubis is usually divided early in the operation, severe hemorrhage at this stage may well mean the difference between success and failure in spite of blood transfusions and other supportive treatment. For this reason every care must be taken to avoid it.

In most accounts of this amputation the separation of the ischiocavernosus muscle and crus penis from the inferior border of the inferior pubic ramus is described as being performed as a step in the denudation of the region of the symphysis before that synchondrosis is sawed or cut through. Not only is this separation unnecessary for that purpose but also the writer considers it inadvisable at this time during the operation for the reason that the deep artery of the penis enters the medial aspect of the crus and, therefore, may be torn when that structure is separated from its bony attachment. Should this occur the torn artery not only is in an inaccessible place but also its tendency to retract adds further to the difficulty of clamping it to arrest the bleeding. It would appear wiser, therefore, to leave the separation of the crus and ischiocavernosus until the internal pudendal artery from which the profunda penis artery arises has been ligated some time later in the operation, either inside the pelvis or as it lies on the external surface of the sacrosciatic ligament, according to the preference of the surgeon.

A further situation fraught with possibilities of severe hemorrhage occurs when the time has come to section the innominate bone posteriorly. Whether this is accomplished by disarticulation of or saw-

ing through the sacroiliac joint or by cutting through the dorsum ilii upward from the great sciatic notch, it must be remembered that the large superior gluteal artery as it issues from the pelvis into the gluteal region through this notch above the piriformis is in close proximity to the inferior end of the sacroiliac synchondrosis. If the gluteus maximus is to be retained, the artery must be preserved and so must be guarded carefully from injury from any saw or chisel being used. On the other hand, if it has been decided to remove this muscle, sacrifice of the artery becomes necessary and should be carried out before the bone is sectioned either by dividing it between ligatures outside the pelvis as it enters the gluteal region or, as preferred by Gordon-Taylor, by securing similar control inside the pelvis of the posterior division of the internal iliac artery of which the superior gluteal is the continuation.

Such considerations as those mentioned in the preceding paragraphs make it clear that the essential points on which successful control of hemorrhage depends are the following: First, the surgeon must be thoroughly conversant with the location and course of all major blood vessels encountered in the amputation; second, these vessels must be sought for deliberately and recognized so that they can be dealt with as the occasion demands and inadvertent injury to them can thus be avoided. Such injury by permitting the retraction of their cut ends into the unfriendly shelter of the pelvis can result in considerable and even fatal loss of blood before hemostasis can be effected.

From time to time reports of hindquarter amputations have appeared in which the control of arterial hemorrhage has been accomplished by ligation of the common iliac artery. Almost invariably this procedure has been followed by some degree of sloughing of the skin and superficial tissues of the posterior flap and this even when the gluteus maximus muscle had been removed. Such necrosis and sloughing means much added morbidity with consequent prolongation of hospitalization, a circumstance which is not always given the consideration it deserves from the economic standpoint. One can visualize the use of the ligation of this artery as an emergency measure to stop arterial hemorrhage which is otherwise uncontrollable and likely to lead to the death of the patient if allowed to go unchecked. However, to carry out a procedure which will almost certainly result in delayed healing and probable infection cannot be accepted as a desirable routine feature of this or any other operation.

The importance of giving multiple transfusions during any operation of considerable magnitude is now so well established that no such operation should be attempted unless facilities for doing so are available since this measure has proved itself the most potent factor we possess in combating hemorrhage and preventing the shock resulting from prolonged handling of tissues. In the present case a blood transfusion was begun within a few minutes of making the incision and the patient was given 2,000 cc. of blood in all while on the operating table. No episodes of serious hemorrhage occurred during the operation so that the amount of blood administered by transfusion exceeded considerably that which was lost. A further 1,000 cc. of blood was given during the first twenty-four hours following the operation. Although such quantities may appear unnecessary in general, the complete absence of primary shock during the operation and of the treacherous secondary shock which often follows severe operations of this type left no regret at our having adopted this course. Although the amount of blood which should or need be given naturally varies with the individual case, the present one would appear to confirm the advisability (1) of beginning to give blood at the outset of the amputation and (2) of giving it in quantities well in excess of the amount lost.

The question has arisen as to the site of ligature of the external iliac artery; whether it should be above or below the origin of the deep circumflex iliac and deep epigastric branches. In making this decision the writer considers the main fact to remember is that these two arteries supply the lower anterior and lateral abdominal parietes. Although sacrifice of these arteries by ligature of the external iliac proximal to their origin is not likely to cause actual necrosis because of the good collateral circulation from the lower intercostal and superior epigastric arteries, one cannot help wondering if it is not responsible for the slow healing which is so often mentioned in the literature. In the present case care was taken to preserve them by dividing the external artery between ligatures placed distal to their source of origin; in view of the perfect healing which took place the writer considers it preferable to preserve these two vessels unless the extent of the tumor is such that their preservation would or might result in its incomplete removal.

Division of Bone. Although some differences of opinion have been expressed from time to time in the literature on the hindquarter amputation concerning the anterior and posterior limits of removal of the innominate bone, agreement seems to have been reached at least on the former because in all of the most recently reported cases the line of section of the bone has been through the symphysis pubis and no attempts have been made to preserve the pubic rami. Thus we can assume that this is now accepted as the standard procedure. Moreover, this anterior line of bone section can be made with relative ease beyond the symphysis through the contralateral pubic bone should the extent of the tumor indicate the advisability of such a procedure.

Opinion regarding the posterior line of bone section, however, does not appear to have achieved such unanimity. For instance, Beck and Bickel in reporting their twelve cases state that the operative procedure used was essentially the same as that described by King and Steelquist. The latter surgeons divided the dorsum ilii upward from the sciatic notch thus following the same technic used by Gordon-Taylor. This technic was also followed in the present case. It is of interest that Gordon-Taylor in his last contribution on the subject of the hindquarter amputation states that he has found the operation to be facilitated by dividing the dorsum ilii before the symphysis pubis. Time will show whether or not this reversal of the present usual routine will become established as the future procedure of choice. Sugarbaker, Ackerman, Pack and Erlich are proponents of a disarticulation through the sacroiliac synchondrosis as the posterior line of bone section, the former authors using a Gigli saw while the latter prefer the mallet and chisel.

Sugarbaker and Ackerman advance a strong plea for minimal total removal of the innominate bone in all cases in which malignant disease involves this bone itself. They consider any less procedure unjustifiable under these circumstances, remarking that "Resulting in perhaps the greatest number of incomplete removals has been the tendency to cut across the sciatic notch leaving all the ilium proximal to that point." Although in the present case in which the dorsum ilii was divided upward from the sciatic notch, the pathologist, from his examinations of the microscopic slides, was satisfied that the posterior line of bone section had allowed a wide margin beyond the microscopic edge of the tumor; yet we believe that Sugarbaker and Ackerman are to be commended on the firm stand they have taken for in doing so they are no more than insisting upon upholding what is well recognized as one of the basic principles governing the successful surgical treatment of malignant disease anywhere in the body, namely, as wide an excision as anatomic considerations will safely permit. There can be no doubt that in removing the whole of the innominate bone

the surgeon will at least have the satisfaction of knowing he has done everything possible to eradicate the disease whereas partial removal will tend to leave him with an uncomfortable feeling of possibly having performed an inadequate operation.

In view of the aforementioned considerations the writer is now of the opinion that in cases of malignant disease involving the innominate bone the posterior line of bone section should be through the sacroiliac synchondrosis and he would accordingly pursue this course in any such future case, leaving section through the dorsum ilii to be considered only in cases of benign tumors of this bone or tumors of the upper thigh in which nothing less than a hindquarter amputation has been deemed necessary for their adequate ablation.

Postoperative Considerations. Wound Healing: The fact that in the present case the patient left the hospital on the sixteenth postoperative day with the wound completely healed, and this although two rubber tissue drains were inserted at the end of the operation and were not removed until the eighth postoperative day, compels the writer to draw attention to certain remarks in the literature. Pack and Ehrlich, for example, make the somewhat surprising statement that continued and often profuse drainage for a period of about three weeks is almost a constant feature following this amputation. Because of the large, bare area inside the skin flaps following a hindquarter amputation it is to be expected that serous or serosanguineous discharge will occur and thus drainage should always be provided for its escape. However, we think it is natural for such discharge ordinarily to cease in a week or so as it did in the present case. For it to continue as long as three weeks, in the opinion of this writer, would certainly lead one to suspect the presence of some complicating factor such as pocketing under the flaps, irritation due to buried sutures or the presence of infection.

Beck and Bickel after stating that the convalescence of their cases was uncomplicated mention that the majority of wounds healed slowly and that in two patients infected hematomas developed, necessitating incision and evacuation while Pack and Ehrlich refer to a high incidence of postoperative wound infections. Since the wound is or should be essentially a clean one, there appears to be no good reason why it should not behave as such; and especially is this so when we now have at our disposal powerful antibiotics and the sulfa drugs to ward off infection or combat it should it occur. Thus when in spite of apparently adequate pre- and postoperative chemotherapy complications such as those mentioned before do arise, one is naturally impelled to inquire as to possible factors which have predisposed to their occurrence; and in doing so one is forced to conclude that such factors are to be found in conditions actually present in the wound when it is closed at the termination of the amputation. Of what do these predisposing factors consist? They include such things as inefficient hemostasis, procedures resulting in inadequate blood supply to the flaps, lack of gentleness in handling tissues with consequent bruising and lowering of their resistance, leaving too much tissue distal to ligatures, etc., all of which we have no choice but to regard as results of failure to pay enough attention to the minutiae of surgical technic and which on occasions can suffice to render ineffective chemotherapeutic measures that ordinarily would be considered adequate. Thus in the present case it was very gratifying that the wound healed by first intention since there was good reason to expect some degree of infection would occur, not only because of the close proximity of the sinus which had drained foul, purulent material from a cavity within the tumor for a long period of time prior to the operation but also because of the possible devitalization of tissues by the previous deep x-ray therapy to which the patient had been subjected.

Phantom Limb: While the pain and other

subjective sensations of which this syndrome consists can be most distressing, the writer was pleasantly surprised at the relative mildness of these symptoms in the present case, particularly as in his experience many cases of more distal amputations have suffered to a much greater extent from this syndrome. Observations by many surgeons show that neither the site of division of the large nerves nor their injection proximal to the point of section with such substances as the local anesthetics or alcohol has any appreciable effect upon the amount of pain, mild or severe, to which this syndrome may give rise in any particular case. We know that it is impossible to predict the degree of severity or duration of this syndrome; and since a satisfactory prophylactic treatment has not yet been evolved, all we can do is keep the patient as comfortable as possible by prescribing sedatives in proportion to the severity of symptoms and hope for their early abatement or disappearance.

Gastrointestinal Function: Pack and Ehrlich state that abdominal distention is practically a constant and occasionally disturbing postoperative complication although other authors make little or no mention of it. Fortunately it did not occur in the present case in spite of the fact that no bowel movements were permitted until the fifth postoperative day so as to lessen the chance of fecal contamination of the wound. The patient was given 1 cc. of a 1:2000 prostigmine solution every four hours for the first forty-eight hours following his operation and after that time the drug was given at less frequent intervals. This routine we have found to be of considerable help in controlling postoperative abdominal distention in major cases; also, surgical interns have repeatedly informed the writer how much they have been impressed by the smooth abdominal convalescence enjoyed by patients who have been given the benefit of this treatment. Although distention might not have occurred in this case even if prostigmine had been withheld, from a long experience in the immediate postoperative use of this drug we believe that it probably played no small part in preventing the occurrence of this complication.

It is interesting to note that most authors report little or no interference with bowel function following the hindquarter amputation, either as regards sphincter control or expulsive force, when we consider that the operation entails the detachment of one of the levatores ani from its origin on the inner surface of the lesser pelvis. A similar report has to be given on the present case for by the time the patient left the hospital sixteen days after his operation he was having daily bowel movements with the same freedom as before his operation. As mentioned previously no bowel movements were permitted until the fifth postoperative day and their management from this juncture was aimed at preventing possible fecal contamination of the wound by control of the bowel movements. In pursuance of this aim aperients were withheld on the basis that they may lead to irregular and urgent evacuations which have to be dealt with in a hurry, resulting perhaps in much discomfort to the patient and possible detriment to the wound by fecal contamination, an important practical consideration in the postoperative care of this amputation. A daily enema was therefore given for several days and at the same hour each day in order to promote regularity until the patient began to have natural bowel movements. Further, each enema was administered with the patient lying on his sound side with the thigh flexed, a large kidney basin being used as a receptacle for the stool. Not only did the patient find this position for the administration of an enema much more comfortable than being perched precariously on a bed-pan but it allowed the wound and dressings to be guarded against fecal contamination more easily and with greater certainty.

Bladder Function: It is generally agreed it is advisable to insert an indwelling catheter of the Foley type for continuous postoperative bladder drainage as repeated catheterization is otherwise likely to be necessary. This was done in the present case with the expectation of leaving the catheter in place for four or five days. However, on the second postoperative day urine began to leak around the catheter which was then removed. Rather than introduce another one immediately it was decided to wait and see if catheterization would be necessary. However, the patient began to void in good quantities without any difficulty. In order to rule out the possibility of retention with overflow the patient was catheterized for residual urine the next day and only about ½ ounce found. From this time to his discharge from the hospital the patient continued to void without any trouble.

Length of Postoperative Hospitalization: So far as the writer has been able to ascertain the present patient had the shortest postoperative hospitalization yet recorded following a hindquarter amputation, being dismissed on the sixteenth day following his operation. Moreover, by this time he had been walking with the aid of his crutches for several days. In most of the reported uncomplicated cases the patient was in the hospital at least four or five weeks following his operation.

Judging from the literature it would seem that even in uncomplicated cases an unnecessarily long period is allowed to elapse after operation before the patient is allowed up on crutches. In such cases there seems no reason why with good support provided for the operative area the patient should not be encouraged to become active as soon as possible. As mentioned previously we had our patient sitting on the edge of the bed on his third postoperative day, standing by the side of the bed on the fourth and trying out his crutches on the sixth. By the eighth day he was able to walk about the room on his crutches. Of course, the fact that he had mastered the use of crutches before his operation was in his favor; however, we believe that even if this had not been so, his progress probably need not have been retarded by more than a few days.

Unfortunately, in the opinion of prosthetic experts no satisfactory prosthesis can be fitted to an individual who has undergone a hindquarter amputation and so, for the purpose of perambulation, he must consider himself dependent upon the use of crutches for the rest of his life.

Length of Survival. We know that in many cases this amputation, like others for sarcoma, has obviously proved itself to be but a palliative procedure for the length of survival of the patient has been of comparatively short duration, being measured in terms of a few weeks to a year or two. Even so, there can be no doubt that the operation, by ridding the patient of a terrible encumbrance, has in many cases been worth while. Moreover, Gordon-Taylor, who began doing this amputation many years before most of those who have recently reported cases, can point to such results as having a patient in sound health seventeen years after this amputation was performed for an osteoclastoma which involved the whole of the innominate bone; a five-year survival after removal of an "enormous chondrosarcoma" of this bone; a patient who suffered from spindle-cell sarcoma of the muscles of Scarpa's triangle alive and well eleven years after operation and a seven-year cure of a chondrosarcoma of the innominate bone. Of more recent cases might be mentioned one of Beck and Eickel whose patient was reported symptom-free three years after this amputation was done for recurrence of a chondroma of the innominate bone. That such gratifying results as these have already been obtained is most encouraging and the diminishing mortality rate of this amputation leads us to hope that reports of similar results will in the future be more frequently encountered.

In the present case the short period of

survival was a great disappointment to us, especially following as it did such an excellent recovery from the operation, and it provided yet another example of the rapidity with which metastasis of sarcoma can overwhelm and destroy an individual. Such an outcome as this immediately focuses the attention on the time which elapsed between the appearance of the tumor and its removal. A biopsy was done shortly after the swelling was noticed but the report of chronic inflammatory tissue suggests that no bony tissue was obtained for pathologic examination and the excellent chance of establishing the diagnosis at this crucial time was thus missed. Because of this report about four months were permitted to elapse before the correct diagnosis was made and the amputation in consequence advised and undertaken. One cannot but think that had this delay been avoided the patient's period of postoperative survival might have been considerably lengthened. Thus we believe that this case is one which serves to emphasize the paramount necessity for, and consequent importance of, the early diagnosis of malignant disease; for if the cure for which the surgeon ever strives and hopes is to be achieved, the rational treatment of adequate removal of the primary tumor must be undertaken before metastasis has had time to occur.

SUMMARY

1. The literature on the hindquarter amputation is reviewed briefly and certain preoperative, operative and postoperative aspects of this amputation are discussed in some detail.

2. A case is reported of osteosarcoma of the innominate bone treated by this amputation about four months after the appearance of the tumor.

3. The patient left the hospital on his sixteenth postoperative day with the wound completely healed. This we believe to be the shortest period of postoperative hospitalization yet recorded following this amputation.

4. X-ray of the chest eight weeks after his operation showed the presence of metastatic involvement of both lungs although at this time the patient was feeling well. He died at home about a month later.

5. This case serves to emphasize the paramount necessity of early diagnosis of malignant disease if the rational treatment of adequate removal of the primary tumor is to be successful.

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According to Voris and Landes, resection of the superior hypogastric plexus is very helpful to overcome pain associated with the bladder or uterus. It is, therefore, of value in cases of dysmenorrhea. However, in chronic cases of long duration these favorable results may not last over a year or two after which time the previously painful condition recurs, perhaps because of regeneration of some of these visceral afferent fibers. The latter assumption has not yet been definitely proven, however. We do know, nevertheless, that this operation often fails to achieve the results expected and for that reason many surgeons, including myself, have stopped doing this operation for dysmenorrhea. (*Richard A. Leonardo, M.D.*)

FRACTURES OF THE SHAFT OF THE FEMUR*

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FRACTURE of the shaft of the femur is usually the result of violent injury and is almost inevitably accompanied with varying degrees of trauma of the soft parts of the thigh which may result in serious complications or sequelae.

Simple fractures of the femoral shaft which receive early and adequate treatment and in which healing occurs without complication have an average period of morbidity of five to six months. In those instances in which there are complications, the eventual outcome may be accompanied with even more serious aspects than the economic loss encountered in the course of a prolonged convalescence. A high incidence of impairment of knee function is reported.[5,7] It is believed, however, that insufficient attention has been directed to the high incidence of other complications that may result from this injury. In an analysis of the cases on which this study is based it will be noted that not only are the complications likely to be many in number but also varied in type.

This is a survey of the results of 176 fractures of the femoral shaft in patients who were observed and treated on the Orthopedic Service of Brooke General Hospital over a period of approximately thirty months. No attempt was made to select patients. Excluded from this study are those patients who had been discharged from the hospital before the survey was initiated and whose records could not be obtained. Also excluded from the end result portion of this study are those whose injury has been so recent that a final evaluation of the end result could not be ascertained. Fractures of the femoral neck, the trochanter and the condyles have purposely been excluded, since these injuries present separate problems in treatment, complications and end results.

Two of the patients died; one death was due to advanced cardiovascular-renal disease in a male eighty-four years of age who suffered a pathologic fracture due to Paget's disease.The other fatality was also a pathologic fracture in a forty-six year old female suffering from carcinoma with generalized metastasis. In this series there were no deaths attributable to the fracture *per se* or to the treatment of the fracture.

The time elapsing before admission to this hospital and the time of injury varied from patients seen immediately after injury to those treated in other hospitals, both civilian and military, for many weeks or months before coming under our care.

Some were combat injuries, but the majority were the results of accidents which may occur in occupations or activities not peculiar to military service. Many received both initial and definitive treatment in various hospitals staffed by civilians, temporary medical officers and by those permanently in the military establishments. Thus the results of the survey represent a fairly accurate cross section of the treatment generally rendered in injuries of this type as well as the results of the injury.

Types of Fractures. Of the 176 fractures of the femoral shaft, thirty-four were in the upper third, 116 were in the middle third and twenty-six in the lower third. Fifty-five were compound fractures. This high incidence of compound injuries may be due in part to the inclusion of the combat wounded in this series. Eight of the patients had bilateral shaft fractures, but for the purposes of this study each fracture was considered a separate entity since each presented separate problems in treatment, complications and in final evaluation. All but five of the patients were males. The average age of the group was twenty-five years. The youngest patient was two years of age; the oldest patient was eighty-four years old.

Causes of Fractures. Automobile or other surface vehicular accidents were the cause of 118 of the 176 fractures. Twenty-seven were due to gunshot or other high velocity missiles. Nineteen of these were the result of injuries incurred in combat. Falls from a great height, including airplane crashes and parachute jumps, caused twenty-one fractures. Five were

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pathologic fractures. Two of these occurred in a paraplegic child who suffered spontaneous fractures of both shafts within a period of several weeks. A third was due to Paget's disease, another to metastatic carcinoma and the last to chronic hematogenous osteomyelitis. In the remaining five, miscellaneous causes, such as blows from an airplane propeller and injuries incurred in athletics, accounted for the lesions.

Concomitant or Associated Injuries. There were many serious associated injuries. The treatment of associated injury often took precedence over the definitive treatment of the fractured femur or materially added to the problem of its management. The complicating injury, therefore, not infrequently influenced the end result of the femoral fracture unfavorably.

The following associated injuries were of sufficient magnitude to complicate treatment or to influence the end result: Thirteen of the patients had severe head injuries. Dislocation of the hip on the homolateral side occurred in two cases and on the contralateral side in two others. There was one avulsion of the patella and fracture of the patella occurred in four additional cases. There was one case of traumatic amputation of the opposite thigh and one of traumatic amputation of the opposite leg. There were two cases of severe burns, three of gunshot wound of the abdomen, one compound fracture of the pelvis, two cases of severe crushing of the thorax and seven cases of sciatic nerve injury. There were thirty-three additional fractures and dislocations associated with the femoral fractures which were not necessarily minor in nature but which did not adversely affect the end result or seriously complicate the treatment.

Evaluation of End Results. In evaluating the end results in this series each patient was placed in one of three categories, namely, unsatisfactory, satisfactory or excellent. Function of the injured extremity was the primary consideration in the classification. Factors which were considered as warranting a classification of *unsatisfactory* were shortening of the extremity of 1 inch or more, limitation of motion of the knee joint to less than 90 degrees of flexion and loss of active extension at the knee joint of more than 10 degrees. Also included in this category are a group of patients with chronic bone infection, non-union or massive bone defects. Most of these were patients with severe combat injuries whose recovery was delayed for so long that for practical purposes a satisfactory end result could no longer be expected. The causes for the various unsatisfactory ratings awarded in these cases are as follows: Shortening, twelve cases; limitation of motion at the knee, thirty-six cases; persistent osteomyelitis, two cases; non-union and massive bone defects, three cases and sciatic nerve palsy, seven cases. In some instances more than one cause for an unsatisfactory rating existed, hen thece discrepancy in the number of complications and the total number of unsatisfactory ratings. (Table 1.) Military personnel in this category were given disability discharges when maximum benefits from hospitalization were attained.

TABLE 1
EVALUATION OF END RESULTS

	No. of Patients	Per Cent
Observed	176	
Evaluated	157	100
Rated as excellent	26	16.5
Rated as satisfactory	89	56.7
Rated as unsatisfactory	42	26.8

A classification of satisfactory end result was given to those patients in whom there was less than 1 inch of shortening, ability to flex the knee to 90 degrees or more, good tone of the quadriceps muscle and where inability to extend the leg at the knee fully was so slight as not to interfere appreciably with function. Military personnel in this category were deemed capable of performing general duty and were discharged to units upon completion of hospitalization.

Cases were classified as excellent when there was no measurable shortening of the extremity, a normal range of motion in all the joints of the lower extremity and no other evidence of impaired function.

Except for certain unsatisfactory cases described previously, all patients evaluated in this series had progressed to the point of partial or full weight-bearing on the injured extremity or were discharged as having attained maximum benefit from hospitalization.

On the basis of this classification the over-all end results are indicated in Table 1.

COMPLICATIONS

The list of complications is indeed a formidable one. (Table II.) It will be recognized that these complications are those of fractures in general, but it is probable that this high incidence in femoral shaft fractures is not appreciated by all who may undertake the treatment of this injury.

TABLE II
COMPLICATIONS OBSERVED IN 176 PATIENTS

Complication	No.
Failure of closed methods of reduction	38
Refracture	27
Non-union	19
Delayed union	12
Malunion	24
Limited union	13
Infection due to injury	16
Infection due to surgery	8
Limitation of knee motion	36
Nerve injury	9
Renal calculi	4
Thrombophlebitis	2

In some cases several complications occurred in the same patient at different stages of treatment. For example, infection and non-union were not uncommonly observed in the same individual, and limited union was frequently followed by refracture. Each complication, however, whether occurring alone or in combination with others had an effect on the management and frequently on the outcome of the case.

Failure of Closed Methods of Reduction. Believing that closed methods of reduction of fractures of the femoral shaft offer the patient the best chances of recovery with the minimum risk, we recognize this failure of thirty-eight cases as a complication of treatment. The reasons for the unusually large number of failures in this series are probably twofold. First, many of these patients came to us for definitive treatment late after the incurrence of injury so that the chances of success from conservative treatment were seriously compromised. Second, after observing the high incidence of late complications in fractures that were not well reduced, we became less hesitant in employing open treatment in an effort to forestall additional complications. In other words, when in the light of our experience delayed union, non-union or malunion were imminent, the patient was given the benefit of surgical treatment.

Refracture. Early in the study it became apparent that too many of our patients were made ambulatory before healing of the fracture was sufficiently advanced to warrant the use of a caliper brace. In other instances patients may have discarded their braces and borne full weight on the injured extremity against advice. In cases of this type an accurate history was often difficult to obtain, in view of the fact that carelessness or non-cooperation on the part of the military patient does have a bearing as to the line of duty status of the refracture.

As to the specific causes of the twenty-seven refractures, seven were caused by too early ambulation. These could represent errors in judgment on the part of the surgeon, in spite of the fact that careful clinical and roentgenologic examinations were made in each instance before the caliper brace or ambulation on crutches was prescribed. One refracture occurred during manipulation of the knee under anesthesia. Seven refractures were attributed to limited union and three to malunion. Full weight-bearing and other prohibited activities on the part of the patient against medical advice caused five refractures. Two cases were due to falls while wearing the brace and two cases were due to flare-up of apparently quiescent osteomyelitis.

Non-union. Watson-Jones states, "Non-union is a complication of the past." He concludes that every fracture unites if immobilization is sufficiently prolonged. Most surgeons who treat large numbers of fractures are inclined to a somewhat less dogmatic view than that expressed by Watson-Jones. Fracture of the shaft of the femur, however, is not one of the injuries usually thought of as being frequently complicated by non-union. In reviewing the nineteen cases of this series in which a diagnosis of non-union was made, no cause for the complication could be found in six cases. In six others inadequate reduction was assessed as the cause. Infection was deemed the causative factor in six cases, and one case was judged as having been inadequately immobilized. (Fig. 1.)

Delayed Union. This condition was diagnosed when the fracture was not completely healed in a period of time normally expected after consideration was given to the anatomic location, the size of the bone and the type of bone involved. It was found to exist in twelve of the cases of this series.

The importance of delayed union lies in the

1A 1B

FIG. 1. A, fracture of the femur complicated by nonunion; the cause of the complication is unknown. Initially treated with skeletal traction for six months; satisfactory reduction was obtained but there was very little callus formation. At the time this x-ray was taken the patient was made ambulant in a snug plaster spica in an effort to stimulate healing. B, shows no evidence of increased callus formation after six weeks of ambulation in plaster; eventually treated with iliac bone graft and metallic plate. This was followed with solid union of the fracture but the end result was unsatisfactory due to partial fibrous ankylosis of the knee.

need for prolonged splinting of the fracture. This often keeps the patient away from work for a long period of time and delay in return of function of the part is not uncommon.

In seven of the twelve cases no cause for the delay in healing could be established. In four cases infection was present and implicated. The remaining failure was attributed to poor reduction of the fracture. (Fig. 2.)

Malunion. This complication occurred twenty-four times in our series. One reason for this unusually large number of cases is that Brooke General Hospital receives complicated cases from outlying hospitals, both in the United States and abroad. Thus 75 per cent of these malunited cases received initial definitive treatment before admission to our service.

Eight cases had shortening of 1 inch or more. This particular deformity was most commonly seen in infected cases that required repeated sequestrectomies in the course of their treatment. In the other types of malunited fractures healing had very often progressed to a point where correction of the deformity by other than operative means was impossible. Sixteen cases were judged as malunited because of inadequate reduction and immobilization. When marked overriding and angulation existed, surgical correction was necessary. (Figs. 3, 4 and 5.)

Limited Union. Carpenter, Rosenfeld and Mech have described a complication of fracture healing to which they have applied the term limited union. This term is most admirably suited to a condition which we have noted in thirteen of our cases. While we were cognizant of this complication before it was described in the literature, it is believed that had it been recognized earlier in the care of these cases, seven of the refractures could have been prevented.

Limited union is not to be confused with delayed union since it is actually a solid bony union, but the end result is a shaft which is not capable of function due to weakness. In this condition union progresses to a point and then apparently stops completely in spite of prolonged protection by splints or guarded use of the extremity in an effort to stimulate callus formation. This condition may occur in both simple and compound fractures. In this series no cause could be found in seven of the cases. In four of the cases the complication was attributed to inadequate reduction (including distraction). Severe comminution was held responsible in one case and the remaining case was due to infection.

Infection. The high incidence of infection in this series (twenty-four cases) would suggest that in spite of careful wound débridement and in spite of commonly employed antibiotic and chemotherapeutic agents, there is still much to be achieved in the management of traumatic lesions. In this series a high percentage of the fractures were compounded and were incurred in places remote from early and adequate treatment. Eleven were, in fact, the result of injuries incurred in combat.

The eight cases due to surgery were analyzed in detail in an effort to screen weak points in treatment. A total of eighty-nine open operations were done on clean cases. These eight cases represent an incidence of 8.8 per cent of infection following surgery. Two followed the use of external bone splints of the Roger-Anderson type. The disastrous results in these cases, in our opinion, make this type of treatment more hazardous than open operation. Two infections occurred in sixty-four operations performed by us. In spite of careful forty-eight-hour preoperative preparation of the skin, excellent operative conditions and careful technic one patient had a frank surgical infection. In the other patient an abscess developed at

2 3 4 5A 5B

FIG. 2. Non-union due to inadequate reduction; initial treatment in overseas hospital. X-ray was taken eighteen weeks after injury and just prior to open reduction; iliac bone graft and metallic plate applied to fracture; result satisfactory. Patient returned to duty eleven months after surgery.

FIG. 3. Compound fracture incurred in combat and complicated by osteomyelitis; one bone graft was unsuccessful and repeated sequestrectomies were performed. There is marked loss of bone substance and non-union. Result unsatisfactory as healing had not taken place after four years of treatment.

FIG. 4. Malunion of fracture; although union appeared to be solid one year after injury, the patient suffered a refracture when he fell while wearing a caliper brace. Refracture treated with application of iliac graft and metallic plate; satisfactory end result on discharge ten months after surgery.

FIG. 5. A, compound fracture complicated by osteomyelitis and limited union; a large sequestrated fragment was removed nine months after injury. The wound healed promptly but limited union is seen in this x-ray taken three months after sequestrectomy; no progress noted on serial x-ray studies. B, limited union treated with iliac bone graft; surgery performed sixteen months after injury. X-ray taken six months after surgery shows solid union and complete incorporation of the graft.

the fracture site three months after time of operation. There is, of course, the possibility that this last case was the result of a blood stream infection, but in an effort to be impartial we have laid the blame to surgery.

In attempting to find the causes for the remainder of the infected cases we are at a loss to assess them to any causes other than poor technic or poor operating conditions. (Fig. 6.)

Limitation of Knee Motion. The frequency of this complication in femoral shaft fractures has led Diggle to propose certain criteria on which the success or failure of treatment of the injury may be measured. He stated that treatment must be regarded as unsuccessful if 90 degrees range of motion at the knee joint had not been attained in twelve months; it should be regarded as successful in only those cases that had achieved this range of motion within nine months.

While we have not adhered strictly to Diggle's criteria for evaluation, we find that serious limitation of knee function was present in thirty-six of the patients who were given an unsatisfactory rating. In twenty-nine sufficient data were available to compile Table III. It will be noted that eleven were compound fractures. Twenty-three were at or below the level of the lower half of the shaft. In all but two cases one or more operative procedures had been performed and all but four cases had some type of complication, either before or after surgery which necessitated prolonged immobilization of the joint.

Charnley is of the opinion that good knee function following femoral shaft fractures is

FIG. 6. Simple fracture complicated by osteomyelitis following surgery; cortical bone graft and metallic plate applied three months after injury. This plate was made three years after initial operation. A draining sinus which was present was injected with lipiodol to show the extensive honeycomb infection of the bone and surrounding tissues. Drainage was present intermittently for years; repeated sequestrectomies were performed; fibrous ankylosis of the knee and 2 inches of shortening were present.

dependent upon early bony union. He presents evidence that there are probably two factors which govern the return of function. These factors are extra-articular adhesions due to scarring of the extensor mechanism and the formation of intra-articular adhesions which result from prolonged immobilization. He regards the latter factor as being of secondary importance in the ultimate return of function. In this series those patients who had clinical union at eight weeks or before had an average range of motion of 114.1 degrees six months after injury. Those in whom union was delayed beyond eight weeks had an average range of motion of only 74.5 degrees six months after injury.

Of the twenty-six patients in this series who were given an excellent end result rating, the average length of time that the knee joint was immobilized was eleven and one-half weeks. The shortest period of immobilization was six weeks and the longest was twenty weeks. These figures would, in our opinion, tend to support the theory of quadriceps damage as being more responsible for impaired knee function than relatively prolonged immobilization.

The fact that all but two of our patients who were rated as unsatisfactory had open operations may at first glance lead one to believe that surgery was a factor in producing impaired function of the knee. However, we find that forty-eight of the patients rated as satisfactory and twelve of the patients rated as excellent had one or more open operations performed in the course of treatment.

It would seem then that aside from excessive damage of the quadriceps, which is quite as likely to occur in a severely comminuted simple fracture as in a severely compounded one, the complications most likely to militate against good knee function are infection, non union, delayed union and refracture.

Nerve Injury. In considering the severity of the trauma usually necessary to produce a fracture of the femoral shaft, it is surprising that the great vessels and nerves of the extremity are not more frequently damaged. Major vascular damage was not observed in any of our patients. Severe lesions of the sciatic nerve, however, occurred as a result of injury in seven cases. In six the nerve lesion was permanent; only one patient ultimately recovered full function of the nerve.

Two additional patients suffered nerve injury as a result of treatment. In one patient peroneal palsy developed following open reduction of the fracture; the paralysis disappeared after a time and no permanent deformity resulted. In the other patient peroneal palsy developed as a result of a poorly fitted cast which was not detected early enough and which resulted in a permanent drop-foot deformity.

Renal Calculi. Four cases is a low incidence for this complication in a group of patients who had been kept in bed for many months and in whom infection and marked bone atrophy were so frequently seen. Two factors may be responsible for this low incidence of stone formation. First, we were dealing largely with a group of healthy young adults. Second, when we developed the practice of bone grafts to supplement delayed and limited union, we hastened convalescence and reduced the time interval necessary to keep patients in bed.

Thrombophlebitis. Each of two patients had open operations and in each instance there were definite signs of pulmonary emboli.

Thrombosis occurred in one case two months after surgery, and in the other case the complication presented itself three months after surgery. This is thought to be a very low incidence of this complication, when compared with surgical cases of similar degree of gravity.

be ideally suited to most simple fractures of the femoral shaft that are seen soon after injury. However, after trying this method in several of our cases, it was abandoned. In spite of good reduction of the fracture under anesthesia and roentgenographic control, it was

TABLE III

IMPAIRED KNEE FUNCTION FOLLOWING FRACTURES OF THE FEMORAL SHAFT

No.	Age	Type	Location	Complication	Surgery	Immobilization
1	28	Compound	Middle third	Failure in reduction	Graft and plate	18 wk.
2	24	Simple	Middle third	Limited union Refracture	Graft and plate	30 wk.
3	33	Simple	Upper third	Malunion Refracture	Graft and plate	16 mo.
4	19	Simple	Upper third	Malunion	Graft and plate	12 wk.
5	36	Simple	Middle third	Malunion	None	13 mo.
6	20	Compound	Upper third	Infection Non-union	Sequestrectomies Graft	3 yr. (approx.)
7	29	Compound	Lower third	Infection Non-union	Sequestrectomies Graft	4 yr. (approx.)
8	36	Compound	Lower third	None	Débridement	16 wk.
9	23	Compound	Middle third	Infection Refracture	Sequestrectomy	20 wk.
10	19	Simple	Middle third	Infection	Plate Sequestrectomies	2 yr. (approx.)
11	20	Simple	Lower third	Delayed union	Graft and plate	20 wk.
12	32	Simple	Lower third	None	None	8 wk.
13	61	Simple	Lower third	None	Excision of fragment	16 wk.
14	43	Simple	Middle third	Refracture (2)	Graft (2)	2 yr.
15	20	Compound	Middle third	Infection	Sequestrectomies	18 mo.
16	23	Simple	Middle third	Non-union Refracture	Graft	23 mo.
17	21	Compound	Lower third	Infection	Débridement	18 mo.
18	26	Compound	Middle third	Infection	Sequestrectomies	30 mo. (approx.)
19	33	Compound	Upper third	Infection	Sequestrectomies	4 yr. (approx.)
20	47	Simple	Middle third	Infection	Sequestrectomies	8 mo.
21	47	Simple	Middle third	Infection	Sequestrectomies	8 mo.
22	28	Simple	Middle third	Delayed union Fractured patella	Graft patellectomy	9 mo.
23	21	Simple	Middle third	Limited union Fractured tibia	Graft	16 wk.
24	28	Compound	Middle third	Non-union	Graft	7 mo.
25	21	Compound	Upper third	Non-union Refracture	Graft (2)	30 mo.
26	36	Simple	Upper third	Infection Malunion	Plate sequestrectomies	18 mo.
27	21	Simple	Middle third	Infection	Plate	12 mo.
28	26	Simple	Lower third	Delayed union	Graft	11 mo.
29	32	Simple	Middle third	Failure in reduction	Plate	16 mo.

TREATMENT

We have found that some form of traction or internal fixation is necessary in the treatment of femoral shaft fractures. Key[4] and others describe methods of reduction by traction and manipulation followed by immobilization in plaster. This type of treatment would seem to

found that over riding recurred after several days' immobilization in plaster and each case eventually came to open reduction.

Of the closed methods of treatment we have found that skeletal traction with the extremity suspended in a Thomas splint and Pearson attachment produced the best results in adults.

Small children of this series were all successfully treated with Bryant's method of overhead traction with adhesive applied to the skin. Except for these cases skin traction with adhesive was not found to be effective since it would not be continued long enough to permit union of the fracture to take place.

We have never found it necessary to use transfixion devices of greater caliber than heavy Kirschner wires. These wires are of sufficient strength to support all the weight necessary to reduce the fracture if it is amenable to reduction by traction. In our hands there have been no instances of infection or ring sequestrum formation following their use. The patients are comfortable and the wires may be left in place as long as necessary for union of the fracture to take place.

Some form of skeletal traction was used in 75 per cent of our patients. In 61.3 per cent of the cases the transfixion wire was placed in the upper third of the tibia near the tubercle. In placing the wire below the knee the hazard of additional damage to the extensor mechanism and capsule of the knee joint is avoided. No ill effects were observed in transmission of the traction force through the ligaments of the knee, as it was never necessary to flex the joint more than 15 or 20 degrees to obtain alignment of the fracture fragments.

Perhaps the greatest hazard to the use of traction over a prolonged period of time is that of overpull or distraction. If this is allowed to exist uncorrected, loss of muscle tone or the interposition of non-ossifiable material may lead to non-union or limited union. This complication can be avoided only by frequent roentgenographic studies of the fracture.

External bone splints of the Anderson, Haynes or Stader type were used in two instances in this series of cases. In each instance severe infection, requiring repeated sequestrectomies, occurred and there was marked impairment of function of the knees. A continuing trend away from this type of treatment is noted by Stuck, Alldridge, O'Donoghue and Roundtree, who reviewed thirty articles on fractures of the femur, over half of which concerned shaft fractures. None of the authors mentioned this type of treatment except to condemn it.

Open Reduction. The risk of infection following surgery is perhaps the most serious hazard to open reduction of any fracture. Because of this every effort must be made to bring about a satisfactory reduction by traction and manipulation, and open reduction should be resorted to only after more conservative measures have failed. The operative treatment of fractures of the femor is justifiable only in ideal surroundings and demands strict aseptic technic. It has been our practice to delay operation until a forty-eight-hour preparation of the skin is accomplished. In the event that open reduction cannot be performed at the end of this time, we prefer to delay operation for a week to ten days to allow swelling to subside or until all superficial abrasions or wounds of the skin have completely healed.

The failure to reduce a fracture of the femoral shaft by other than operative means should be considered as an admission of failure on the part of the surgeon responsible for the case. However, the reluctance to perform open reduction should not be carried to the point at which other serious complications are certain to occur, unless the benefits of surgery are made available to the patient. The success or failure of conservative attempts to reduce the fracture satisfactorily can be determined within a few days after treatment is instituted. In the event of failure the operation should not be delayed as early operation reduces technical difficulties and favors early union.

Except possibly for the Kuntscher type of intramedullary nail which was used only once in this series, no form of internal fixation yet devised is strong enough to dispense with postoperative external splinting of some type. In approximately half of our cases plaster casts were used for eight to twelve weeks following open reduction. In the remainder balanced suspension and skeletal traction were used postoperatively. No difference in the end results were noted between the two types of postoperative splinting.

Equally good results were obtained with plates and screws made of vitallium® or of 18-8-SMo steel. Tissue reaction due to electrolysis was never observed as long as there was no variation in composition between the plates and the screws. Whenever feasible we have endeavored to hold the plates in place by screws that were long enough to engage both cortices of the shaft. Additional rigidity was often obtained by transfixing screws placed across the fracture line at right angle to the screws holding the plate.

The complications of delayed union, non-

union and limited union were treated with bone grafts as soon as possible after the diagnosis was made or whenever clinical and x-ray studies indicated that these complications were imminent. In our experience bone from the iliac crests has been established as the material of choice for bone grafts. The rapidity with which cancellous bone becomes incorporated at the fracture site together with the osteogenic stimulating property which, it possesses makes it superior to cortical bone. In cases in which rigid internal fixation was required at the fracture site, the use of a metallic plate was combined with the bone graft.

The frequent use of reinforcement iliac grafts in certain cases of this series in which the complications of delayed union and limited union developed, has in our opinion, not only greatly reduced the period of hospitalization but has also prevented the occurrence of more serious complications such as refracture and serious impairment of knee function in many of our cases.

SUMMARY

The causes, treatment and complications of 176 unselected femoral shaft fractures have been presented. In 157 cases an evaluation of the end result was possible.

Serious complications frequently occur in femoral shaft fractures and may result from the injury itself or from treatment.

Reduction of the fracture by skeletal traction and manipulation offers the patient the best result with minimum risk.

Open operations on fractures of the femoral shaft should be performed only under ideal conditions. However, this type of treatment should be resorted to when necessary to accomplish a satisfactory reduction and to forestall late complications of the injury.

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TRAUMATIC SUBCUTANEOUS INJURIES TO THE PANCREAS*

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TRAUMATIC subcutaneous injury to the pancreas without penetrating wounds is sometimes termed traumatic pancreatitis, but regardless of terminology it is a rare intra-abdominal condition. The first case of traumatic subcutaneous rupture of the pancreas was reported by Travers[1] in 1827; since then many case reports of pancreatic injuries have appeared in the literature. We are reporting four cases of traumatic subcutaneous injury observed by us at Harlem Hospital, New York.

According to the literature trauma accounts for only from 2 to 4 per cent of all cases of acute pancreatitis. Schmieden and Sebening[2] in a series of 2,137 collected cases of acute pancreatitis found that only sixty-two were of traumatic origin. Truesdale[3] found only one of fifty-four cases to be of traumatic origin. In 1931 Judd, Mattson and Mahorner[4] reported eighty-eight cases of cysts of the pancreas that had been operated upon by them; none were considered to be due to trauma. Lloyd[5] was among the first to point out that the majority of pseudocysts following abdominal injury were not true retention cysts of the pancreas. He reported two cases, both occurring after abdominal injury; one occurred three weeks and another three months after trauma. He expressed the opinion that both were associated with injury to the pancreas, probably by pressure against the first lumbar vertebra.

Cushing[6] was the next observer to report a case of traumatic rupture of the pancreas followed with cyst formation. Rabinovitch and Pines[7] in a detailed study of seventeen cases found that none of their cases could be traced by them directly to trauma. Some evidence has been brought to bear experimentally that trauma is an important causative factor in the production of pseudocysts of the pancreas; this is our opinion. Lazurus[8] was able to produce such a cyst by crushing the pancreas of a dog. A hematoma first formed which later became an encapsulated cyst and contained 100 cc. of milky fluid. It is our opinion that trauma, often unrecognized, is the basic factor in the production of pseudocysts of the pancreas. In this we agree with Rabinovitch and Pines[7] that it does not account for all cystic processes involving the pancreas but is a reasonable explanation for most of them, except in cases of chronic alcoholics. Shallow and Wagner[9] found only one case in their twenty-eight cases of acute pancreatitis that was of traumatic origin. At Harlem Hospital during the period from 1936 to 1946 there were seventy-five cases of acute pancreatitis. Of these four were due to trauma which gives a percentage of 5.3.

Subcutaneous injury of the pancreas is rare in relation to subcutaneous injury of the abdominal viscera and also in relation to acute pancreatitis in general. In two previous papers[10,11] on subcutaneous rupture of abdominal viscera it was shown that such injuries of the pancreas are rare. Table I is taken from the article on subcutaneous rupture of the liver without penetrating wounds. The pancreas was involved to the extent as shown in the table.

The age and sex incidence in this series shows that all of our cases occurred in young males of ages six, seventeen, seventeen and twenty-four, respectively.

Shallow, Eger and Wagner[12] state that "pancreatitis is rare in the colored race." In the past ten years at Harlem Hospital we have treated seventy-five patients with acute pancreatitis. Seventy-two of these patients were Negroes.

The types of trauma reported in our cases are found in Table II. Other types of trauma to the back and abdomen have been reported as causing subcutaneous injury to the pancreas. Due to the fact that a subcutaneous rupture of the pancreas may result from a mild form of abdominal trauma as well as a severe form, it is not unusual that there are no associated intra-abdominal injuries. Our study of the literature

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reveals that traumatic pancreatitis without injury to other organs is exceptionally rare. Schmieden and Sebening[2] in 1928 were able to find only twenty such cases. Stern[13] reported in 1930 that "traumatic pancreatitis in which the only organ injured is the pancreas is an exceptionally rare condition." We cannot support this view as all four cases in this report had no associated injuries that could be determined clinically or at operation.

TABLE I
INCIDENCE OF RUPTURE OF THE LIVER AND OTHER ABDOMINAL VISCERA WITHOUT PENETRATING WOUNDS IN TWO SERIES OF CASES

Organ Ruptured	Present Series of Cases 1935–1946		Previous Series of Cases 1928–1938		Totals	
	No.	Percentage	No.	Percentage	No.	Percentage
Liver*	27	38.6	18	28.6	45	33.8
Spleen	23	30.7	30	47.6	53	38.4
Intestines	16	21.3	11	17.5	27	19.5
Mesentery	2	2.7	3	4.7	5	3.6
Pancreas	2	2.7	1	1.6	3	2.2

* Five cases not included in the twenty-seven occurred between 1935 and 1938. However, they have never been described before. The cases of ruptured spleen, intestines, mesentery and pancreas do not overlap in the two series of cases. (Courtesy of *Arch. Surg.*, 54: 613–632, 1947.[11])

The pancreas embryologically is encased in peritoneum. However, as the fetus develops, the posterior surface is covered with connective tissue while the borders and anterior surface are continuously covered with reflection of peritoneum, the posterior wall of the lesser peritoneal cavity; and so the pancreas becomes encased in its only capsule. The lesser cavity in turn is enclosed anteriorly by the gastrohepatic omentum, the stomach, gastrocolic omentum and mesocolon, having connections with the greater peritoneal cavity only through the foramen of Winslow. The pancreas is so located that its head and part of the body lie at the level of the first and second lumbar vertebrae and lie across the ascending vena cava and abdominal aorta while the rest of the body and tail of the pancreas extend to the left. In front of the pancreas are the stomach, small intestines and transverse colon while above and to the right is the liver and to the left the spleen. The pancreas is extremely vascular and its structure is such that insignificant trauma may result in serious intraperitoneal hemorrhage.

TABLE II
TYPES OF TRAUMA

Kicks in the abdomen	2
Struck by an automobile with rear wheel passing over chest and abdomen	1
Ran into the side of a push cart striking abdomen	1

Venable[14] from a pathologic point of view classifies ruptures of the pancreas as (1) incomplete ruptures and (2) complete ruptures. Incomplete rupture of the pancreas is a tear in the parenchyma of the gland with an intact capsule. Complete rupture means a tear in the capsule as well as glandular tissue. Mild and moderate degrees of contusion of the pancreas may cause rupture of the small and medium-sized blood vessels, and inflammation occurs with the extravasation of blood into the tissues. The extravasated blood collects until the limits of the capsule are reached. It is at this time that the tension or pressure on the capsule causes excruciating pain and shock. When the capsule ruptures, there is an immediate flooding of the lesser peritoneal sac with pancreatic juices. The digestive ferments of the pancreas also cause further destructive changes in the vessels of the pancreas. Mikulicz[15] points out the influence of the pancreatic ferments in cases of injury to the gland and states that the escape of the ferments from the damaged portion of the gland is responsible for causing the characteristic signs of acute hemorrhagic pancreatitis, fat necrosis, localized peritonitis and, in the later stages when infection is added, pancreatic abscess. In complete rupture of the pancreas the signs of an acute condition within the abdomen develop immediately whereas in an incomplete rupture the signs may not develop for weeks or months later. Incomplete ruptures may go on to abscess formation, formation of a pseudocyst of the pancreas, or the tension within the gland may gradually increase and give signs of an acute condition within the abdomen when the extravasated blood and pancreatic ferments produce a rupture through the capsule of the pancreas.

A clinical classification of traumatic pancreatitis depends on the time of appearance of the abdominal signs in relation to the time of the abdominal injury and the severity of the ab-

dominal signs when they develop. We use the following classification:

Subclinical. These are cases in which, following a history of trauma, the signs and symptoms of intra-abdominal injury are mild and disappear within twenty-four to forty-eight hours. Because the injuries, signs and symptoms are mild, most of these patients do not come to the hospital. The pathologic condition is usually mild edema of the pancreas.

Clinical. Acute: These are cases in which the signs of intra-abdominal injury appear immediately and are severe such as contusion of the pancreas, incomplete rupture of the pancreas and rupture of the pancreas. The signs and symptoms may persist for from twenty-four to seventy-two hours. *Subacute:* These are cases in which the symptoms and signs persist for seventy-two or more hours; always severe contusion or incomplete rupture. These cases may go on into a chronic or delayed phase because of lack of clinical recognition. *Delayed rupture of the pancreas:* These are cases in which the trauma is mild. Usually there are no signs or symptoms of serious abdominal injury at the outset, but later signs and symptoms of an intra-abdominal pathologic condition gradually develop. These are the cases in which a pseudocyst of the pancreas or abscess of the pancreas develops.

As to symptomatology, Moynihan[16] has stated that "no other condition produces such unendurable agony and such profound collapse as seen in pancreatic injury." In our four cases this was not true as not a single patient was in shock. The pain was only moderate in two cases and only slight in the other two instances. Neither did our patients present the symptoms usually described in the literature as associated with pancreatic injury, namely, extreme pallor, dyspnea, cold sweats, rapid pulse and falling blood pressure. There was nausea and vomiting in three of our cases. The abdominal signs were as follows: Case I, generalized abdominal tenderness, no rigidity or rebound tenderness; Case II, generalized abdominal tenderness and rigidity; Case III, generalized abdominal tenderness, most marked in the epigastric region, no rigidity or rebound tenderness; Case IV, abdomen soft, flat and non-tender, with a mass in the left hypochondrium which appeared thirty days after the original injury.

The diagnosis of traumatic injury to the pancreas without penetrating wounds is a difficult one to make. There is usually generalized abdominal tenderness which is frequently more marked in the epigastric region. Initial vomiting is the rule but this vomitus contains only gastric contents. At this stage it is hard to differentiate the condition from that caused by a blow to the solar plexus or violence to other intra-abdominal viscera. If, however, after sixty-eight hours the severity of the abdominal pain decreases and becomes localized in the epigastric region, the possibility of pancreatic injury of the incomplete type of rupture should be borne in mind. Days, weeks or even months may elapse between the time of the initial disability caused by incomplete rupture and the subsequent breaking down of the capsule of the pancreas and the formation of a pseudocyst with its mechanical syndrome. In this group of cases the symptoms of an acute condition within the abdomen developed in twelve hours, thirteen hours, ten days and fifty days, respectively.

In traumatic intra-abdominal injuries the differential diagnosis rests between ruptured liver, ruptured spleen, rupture of the small or large intestines, perforation of the stomach, injury to the solar plexus, contusion of the abdominal wall and traumatic pancreatitis. When the hollow viscus is ruptured, the demonstration of pneumoperitoneum aids in the diagnosis. In general, in traumatic injuries of the abdomen an abdominal tap is recommended; and if any bloody fluid is obtained, it is of diagnostic importance because it indicates a rupture of the spleen or liver or a tear of a large mesenteric vessel. It must be remembered, however, that a negative tap does not rule out intra-abdominal injury. If a fluid that is not bloody is obtained and this amount is over 3 cc., it should be sent to the laboratory for an amylase determination. If the amylase value of this fluid is high, it points to injury of the pancreas. Rothman[17] at this hospital was the first to point this out. However, amylase determinations, should also be done in all injuries to the abdomen which are non-penetrating because an elevated serum amylase points to traumatic pancreatitis, except in cases of chronic alcoholics as pointed out by Carter.[18]

CASE REPORT

Case I. The patient, a male child aged six, was admitted with a history of having been struck by an automobile. It was stated that the rear wheel of the car passed over the chest and

abdomen of the child. He complained of generalized abdominal pain.

Examination of the head revealed abrasions about the right occipital region. There were no signs of fractured ribs. The abdomen was soft and flat. There was tenderness over the entire abdomen but no rebound tenderness or rigidity. The impression was possible intra-abdominal injury.

X-ray examinations of the chest were negative and x-rays of the abdomen were negative for pneumoperitoneum. An abdominal tap was negative in four quadrants.

At operation traumatic hemorrhagic pancreatitis was found, with hemorrhage into the body of the pancreas over an area about 6 cm. in diameter. The abdomen was closed in layers without drainage. The patient made an uneventful recovery. His temperature was normal on the tenth postoperative day.

This case represents the type of complete rupture in which symptoms of an acute condition within the abdomen appear immediately after the injury. This patient was seen in 1935 and no serum amylase or urine amylase studies were done.

Case II. The patient, a seventeen year old male, was admitted to the hospital complaining of generalized pain on August 9, 1945, shortly after he was kicked in the abdomen.

Abdominal examination showed moderate tenderness in both upper quadrants, being greater in the epigastric region. There was no rebound tenderness or rigidity. The rest of the physical examination was negative.

On August 10, 1945, there was a localized, tender swelling over the left upper rectus muscle, probably a hematoma of the rectus muscle. The rest of the abdomen was soft, flat and nontender. On August 11th his general condition was good. He was out of bed and had no complaints. Tenderness persisted over the swelling over the left upper rectus muscle. In August 16th there was only slight tenderness over the left upper rectus muscle and the tender mass was smaller in size. The patient was discharged.

The patient was readmitted to the hospital on September 28, 1945. He stated that since his discharge from the hospital he had been weak and had vomited frequently. Two weeks before this admission the patient had observed a painful mass, progressively increasing in size, in the left upper quadrant.

Examination of the abdomen showed there was a firm, globular mass in the left hypochondrium about 12 cm. in diameter. The rest of the abdomen was soft, flat and non-tender. Serum amylase was 175 units. X-ray of the abdomen showed clouding in the epigastrium suggestive of a retroperitoneal mass. The impression was pseudocyst of the pancreas following pancreatic injury.

At operation a pseudocyst of the pancreas was found which pushed the stomach forward and pushed upward the gastrocolic and gastrohepatic omentum. The cyst contained about 400 cc. of dark brown fluid. The cystic wall was fixed to the peritoneum and drained. Postoperatively the patient made an uneventful recovery and the drainage from the pseudocyst stopped on the eighth postoperative day. On the day of operation the fluid from the cyst was found to have 5,440 units of amylase and the blood amylase the same day was 110 units. On the second postoperative day the drainage from the cyst had only 105 amylase units and the blood amylase was 90 units. On the fifth and seventh postoperative days the amylase content of the fluid draining from the cyst was 85 units of amylase and the blood amylase was 80 units.

This case represents the incomplete rupture of the pancreas in which the symptoms of an acute condition within the abdomen subsided shortly after the injury. This incomplete rupture of the pancreas went on to pseudocyst formation. This case illustrates the high value of serum amylase that exists in the fluid of a pseudocyst of the pancreas. The amylase level of the cystic fluid in this case was 5,440 units. Popper[19] has demonstrated that large amounts of amylase and lipase are present in the peritoneal exudate of dogs within an hour or two after the development of pancreatic edema. We believe that this is also true in man. It is because of this that in non-penetrating traumatic injuries to the abdomen an abdominal tap in all four quadrants should be done; and if the fluid is not grossly bloody, it should have an amylase determination performed as a high amylase level would point to injury to the pancreas.

Case III. About thirteen hours before admission, a twenty-four year old male, was beaten by three men. During the assault these men kicked the patient in the abdomen. There was no loss of consciousness. Following the attack the patient vomited several times and began to have moderate generalized abdominal pain.

Examination showed the abdomen to be moderately tender throughout, but more marked in the epigastric region. The rest of the physical examination was essentially negative. The impression was intra-abdominal injury.

At operation, seen scattered over the omentum, peritoneum and surface of the small intestine were numerous small caseous nodules yellowish white in color. These nodules varied in size from .5 to 1 cm. in diameter. One of these areas was removed and placed upon a glass slide; and when 20 per cent aqueous solution of copper sulfate was added, a green color resulted which proved the presence of fat necrosis. No free fluid was found in the lesser sac. The pancreas was enlarged and boggy. It was red in appearance but there was not a tear in the capsule of the pancreas. A tampon of gauze covered by a large rubber dam was placed into the lesser sac over the anterior surface of the pancreas and was brought out through the upper portion of the wound. The rest of the wound was closed in layers.

On the first postoperative day there was a bloody, purulent discharge from the lower angle of the wound. The urine and blood showed amylase to be present in excess of normal. The blood sugar was 197. Microscopic diagnosis of a specimen of tissue removed at operation revealed fat necrosis of the omentum. On the fourth postoperative day the patient complained of severe abdominal pain. The abdomen was tender and rigidity was present. Examination of the wound showed a brownish-yellowish discharge coming from the lower angle of the wound. Part of the packing was removed. On the fifth postoperative day the patient's temperature was 101.4°F. The abdomen was tender and rigid in the upper quadrants. A profuse, brownish black discharge from the lower portion of the wound was present. Examination of this fluid revealed the presence of amylase and bile. The patient made a slow and uneventful recovery and all drainage from the wound stopped on the thirty-fifth postoperative day.

This case was reported from this hospital by Smith[20] and it represents an incomplete rupture of the pancreas. The drainage from the peritoneal cavity contained amylase although there was no apparent tear in the capsule of the pancreas. This is in line with the findings of Popper[19] in dogs in that the peritoneal exudate in pancreatitis contains amylase.

Case IV. The patient, a seventeen year old male, stated that while running down a dark street he struck his abdomen on the edge of a pushcart. This occurred about six hours before admission. On admission the patient complained of generalized abdominal pain.

There was tenderness in both upper quadrants of the patient's abdomen but no rigidity or rebound tenderness. No masses were palpable. The rest of the physical examination was essentially negative. X-rays of the abdomen were negative for pneumoperitoneum and an abdominal tap was negative in all four quadrants. The impression was contusion of the abdominal wall.

Twenty-four hours after admission the patient had no complaints and his abdomen was soft, flat and non-tender. The patient was discharged symptom-free on the fourth day.

On the sixth day after the injury while at home the patient was seized with severe pain in the upper abdomen associated with nausea and vomiting. The nausea and vomiting have persisted since their onset. The patient was readmitted to the hospital ten days after the initial injury.

The abdomen was tense and rigid throughout. A soft mass was present in the left hypochondrium, which extended to the flank. The abdomen was moderately distended. X-ray of the abdomen was negative for pneumoperitoneum.

At operation the lesser peritoneal sac was fully distended and contained about 700 cc. of serosanguineous fluid, with many pieces of dark brown capsule. The foramen of Winslow was blocked. No tear in the capsule of the pancreas could be demonstrated. The lesser peritoneal sac was aspirated and three drains were placed in it and brought out through the lower angle of the wound.

The patient made an uneventful recovery. The drains were removed on the sixteenth postoperative day. The drainage from the wound stopped on the twentieth postoperative day. The blood sugar was normal; the blood amylase, urine amylase and amylase in the fluid obtained by draining in this case were elevated.

This case has been the subject of a report by Rothman[17] on the use of the amylase test on the abdominal fluid. In this instance there was an incomplete rupture of the pancreas that developed symptoms on the tenth day after the initial injury. In this case, however, there was an elevation of the amylase content of the

drainage from the lesser peritoneal sac although there was no apparent rupture of the capsule of the pancreas. The serum amylase also remained elevated.

The treatment of traumatic pancreatitis is immediate operation. The reason for this is that in the case of traumatic subcutaneous rupture it is our opinion that drainage of the lesser peritoneal sac is indicated. A midline incision from the ensiform cartilage to the umbilicus should be used. After opening the peritoneal cavity the pancreas may be reached in one of the following ways: (1) above the stomach through the gastrohepatic omentum, (2) below the stomach through the gastrocolic omentum and (3) through the transverse mesocolon. The route below the stomach is usually chosen. A bloodless area in the omentum below the greater curvature is found and incised. The lesser peritoneal sac is thus opened and the pancreas exposed. Extensive disintegration of the gland should be treated using gauze tampons and drainage. All cases of traumatic injury to the pancreas should be drained. The treatment after operation is supportive treatment, which means intravenous fluids, plasma and blood when indicated.

Whipple[21] describes a syndrome of pancreatic asthenia in which the patient is listless, apathetic, unresponsive to those around him, lacks appetite, complains of nausea and may vomit, rapidly becomes emaciated and complains of extreme exhaustion. These symptoms are said to appear within two or three days but are sometimes delayed for many days. This syndrome of pancreatic asthenia was not noted by us either pre- or postoperatively.

CONCLUSIONS

1. Traumatic injury of the pancreas without penetrating wounds is a rare condition.

2. Serum amylase studies should be made in all cases in which injury of the pancreas is suspected.

3. If non-bloody fluid is aspirated from the abdomen on abdominal tap in cases of suspected pancreatic injury, amylase determinations should be carried out on that fluid.

4. The treatment of traumatic pancreatitis is operation with drainage of the lesser peritoneal sac.

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PENETRATING WOUNDS OF THE CHEST*

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DURING the recent war years much was written on the treatment of penetrating chest wounds. For the most part this consisted largely of radical surgery necessary for the proper care of these patients and which gave uniformly good results. In addition to experienced surgeons emphasis was placed on the importance of having trained anesthetists well versed in endotracheal anesthesia and well equipped hospitals providing easy access to blood, plasma and specialized laboratory procedures. When the general surgeon or practitioner reads of these complicated procedures required for the seemingly correct care of these cases, he is apt to become quite dismayed.

This apparent serious problem was attacked by the surgical staff at the U. S. Naval Hospital in Charleston, S. C., where, although all of the prementioned requirements were available, a strict form of conservatism was adhered to and in no case was any form of therapy used which is not immediately available to physicians practicing in remote regions with little equipment.

It was found early in the study that there was a great difference between penetrating wounds seen in warfare and those of peace time practice. They were, in all cases, single rather than multiple and of small size, either small caliber bullets or clean knife wounds. The bullets gave a through-and-through wound bearing no foreign bodies. The small caliber of bullet or knife gave self-sealing wounds in practically all cases. They were clean wounds which, coupled with the short interval between injury and adequate professional care available, permitted primary closure. In general the injuries were a far cry from the severe multiple chest wounds seen during World War II.

It is the purpose of this paper to re-evaluate recent literature on penetrating chest wounds and re-emphasize conservatism in their care.[10]

Penetrating (not open) wounds of the chest are usually intrathoracic and are caused by knives, ice picks (stab wounds) and small caliber bullets (gunshot wounds). This pathologic condition is in contradistinction to open sucking wounds of the chest. Hemothorax or pneumothorax separately or in combination may develop following small penetrating wounds. Hemothorax is present in about 70 per cent of all chest wounds. Specifically, in another review of a series of 1,639 cases, hemothorax occurred in 62.6 per cent.

Thoracic trauma is different from trauma occurring elsewhere in the body. The alterations in negative pressure in the pleural cavities following penetrating intrathoracic wounds cause partial collapse of the lung on the affected side and produce the classical symptoms of respiratory distress. The degree of the resultant respiratory embarrassment may vary from very slight deviation of the normal to one with grave results. Besides the negative pressure consideration within the pleural cavities, the blood pressure of the pulmonary circulation is one-sixth that of the peripheral systemic circulation. These factors are paramount when one considers both the mechanism of hemopneumothorax and its treatment. The pressure of the blood alone in an increasing hemothorax may be insufficient to control continuous hemorrhage. Fortunately, however, bleeding from the simple kind of lung injury under discussion is rarely profuse because of the lowered pulmonary blood pressure and is usually self-limiting. Ordinarily, the blood within the pleural cavity does not clot. Usually about 10 per cent of the hemothorax cases are reported to reveal clotting.[18,21] If intrapleural clotting does occur, it is due to an associated infection.

SYMPTOMS AND SIGNS

Certain subjective symptoms and objective signs are constant findings in penetrating wounds of the chest. Respiratory distress and

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pain are especially noted. Changes in the breath sounds on auscultation from diminished breath sounds to their complete absence was elicited in 80 per cent of the cases. This physical finding is so constant that careful examination of the chest is tantamount to the subjective pain and respiratory distress in the establishment of the diagnosis of hemopneumothorax.

TABLE 1
PERCENTAGE OCCURRENCE OF SYMPTOMS AND SIGNS

Symptoms and Signs	Incidence	
	Author's Series	McMahon's Series
Dyspnea	60	70
Pain	40	30
Hemoptysis	20	47
Cough		50
Alterations in:		
Breath sounds (decreased to absence)	80	
Voice sounds, tactile fremitus	60	
Dullness		
Hyper-resonance	50	
Tympany	30	
Mediastinal shift		
Splinting of affected side	40	

McMahon[10] treated 278 patients with chest wounds, both perforating and nonperforating. These were casualties during World War II. Statistical data of this series of cases are included in Table 1.

Limitation of motion on one side usually indicates compression of the lung of that side by blood or air, which amount within the pleural cavity also determines the degree of the physical finding changes elicited.

Roentgenograms. If the amount of bloody effusion reaches 400 to 500 cc., a positive shadow by x-ray is obtained. The shadow outlined may include both compressed lung and blood. If fluid alone is present in the chest, a lateral upward sweep of the fluid level is seen. A free, flat or horizontal fluid level is visualized only if air is present. Expressed differently a flat or horizontal fluid level is not found in hemothorax but may be observed in hemopneumothorax. This is readily demonstrated in the accompanying x-ray films.

TREATMENT

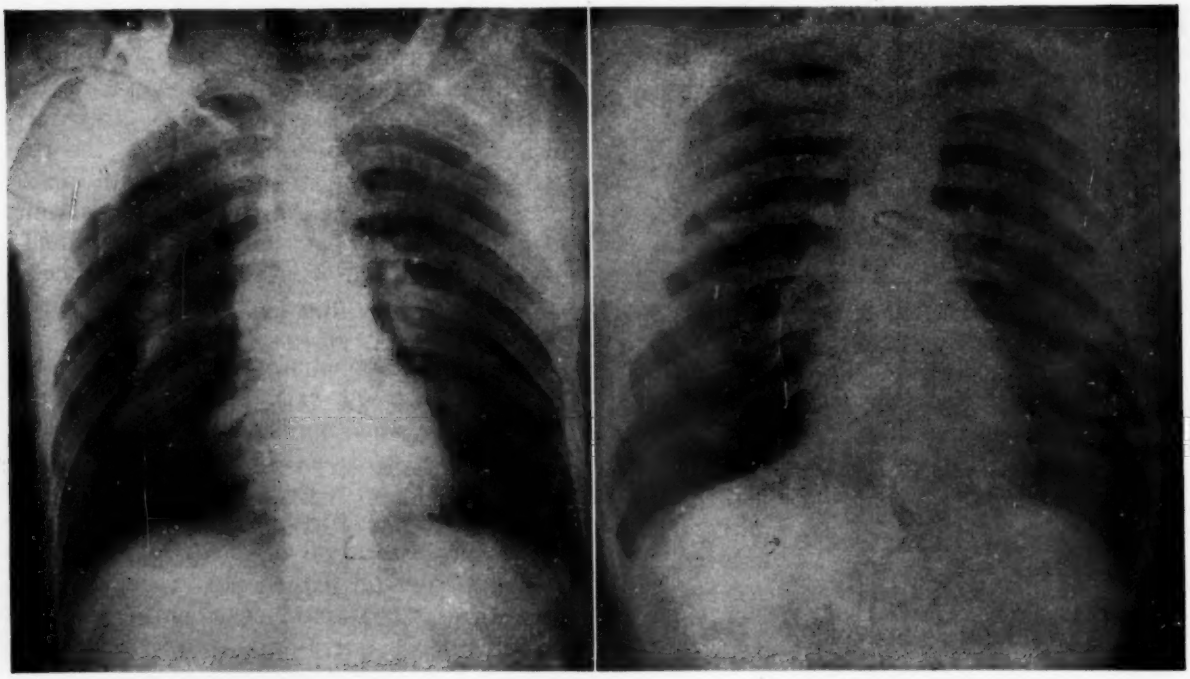
A plea for conservatism is made in the treatment of penetrating (not open) wounds of the thorax. The small bloody effusions are nearly always absorbed spontaneously and the partially collapsed lung will fully re-expand in six to eight weeks. There is no need for surgery and possible secondary contamination through surgical intervention. Yet surgery is indicated when relief does not result from conservative treatment.

Definitive treatment as carried out on our surgical service follows: Minor débridement of the external wound and suture of the wound in layers without tension is performed. The pleura is closed along with the suturing of the chest wall wound. An airtight dressing over the wound for restoration of negative pressure is applied. Penicillin parenterally (100,000 units every three hours) is of considerable value in the control of micro-organisms. Besides the antibiotics, sulfonamides are used occasionally; however, chemotherapy was not used as extensively as penicillin.

The patient is confined to bed seven to nine days. As to position during bed rest some patients were more comfortable lying flat in bed, others preferred a semi-reclining position. Patients were allowed their own preference in this regard. It is desirable to keep the patient quiet and avoid unnecessary excitement or coughing. Analgesics and sedatives are used. Oxygen inhalation is instituted for those with obvious respiratory embarrassment.

Thoracentesis is a procedure carried out only after proper and considered evaluation of the clinico-pathologic picture. For larger bloody effusions aspirate for relief of pressure symptoms and as a prophylactic measure toward the prevention of complications (fibrothorax, empyema). Aspirate air as well as blood, withdrawing not more than 1,000 cc. at one time. It is better to do the thoracentesis after forty-eight hours. Repeat the aspiration if necessary. Do not aspirate and follow with introduction of penicillin locally into the pleural cavity. Since the African Campaign (1943) it is no longer the practice to aspirate with air replacement (Bastianelli).

Supportive treatment combatting traumatic shock and uncontrollable hemorrhage may be necessary in rare cases. Transfusion of whole blood and plasma and the ligation of chest wall



1 2

FIG. 1. Case 1. Knife wound of chest showing a right pneumothorax with 75 per cent lung collapse; no fluid present; heart shadow normal.
FIG. 2. Case 1. Complete re-expansion of right lung after two weeks; still no fluid present.

vessels to control the bleeding must be carried out.

Tetanus toxoid 0.5 cc. (intramuscularly) as a stimulating dose is given to those patients who have previously been immunized against tetanus. Nonimmunized patients are given tetanus antitoxin (1,500 to 3,000 units).

Adjuvants in the treatment consist of nourishing diet and vitamins. Wagensteen suction had been used with success in one of the cases of hemopneumothorax of the left side for relief of vomiting.

CASE REPORTS

A review of a few illustrative cases may best emphasize the various problems met with in the management of penetrating wounds of the chest.

CASE 1. R. J. (No. 65024), a twenty-two year old white male, was admitted to the surgical service on April 15, 1947, with a history of having been stabbed several times in a fight. Physical examination showed a poorly nourished male with no acute distress but with multiple lacerations of trunk and arms; all were superficial except one deep wound in the posterior right chest. A percussion note over the right chest was tympanitic with absent breath sounds. The pulse rate was 100, respirations 24, temperature 100.2°F. and blood pressure 108/72. Blood count was normal.

The patient was given 1,000 cc. of plasma and taken to the operating room where the deep laceration of the posterior chest was found to extend obliquely down and through the pleura but had sealed itself. The wound was closed in layers. Penicillin was given parenterally and sulfadiazine. The patient remained febrile for the first several days only. An original chest film (Fig. 1) showed 50 per cent lung collapse with a small amount of fluid. On the fourth hospital day there was two-thirds lung re-expansion and no fluid. Sutures were removed on the seventh day and the patient was allowed out of bed on the fifteenth day at which time a chest radiograph showed complete lung re-expansion (Fig. 2); the patient was discharged on same day. The diagnosis was right pneumothorax.

CASE 11. L. O. (No. 67515), a twenty-one year old colored male, was admitted to the surgical service on September 27, 1947, with a history of being stabbed with a butcher knife during a fight. Physical examination showed a well developed male with rapid, shallow respirations. There was a 5 cm. stab wound of the

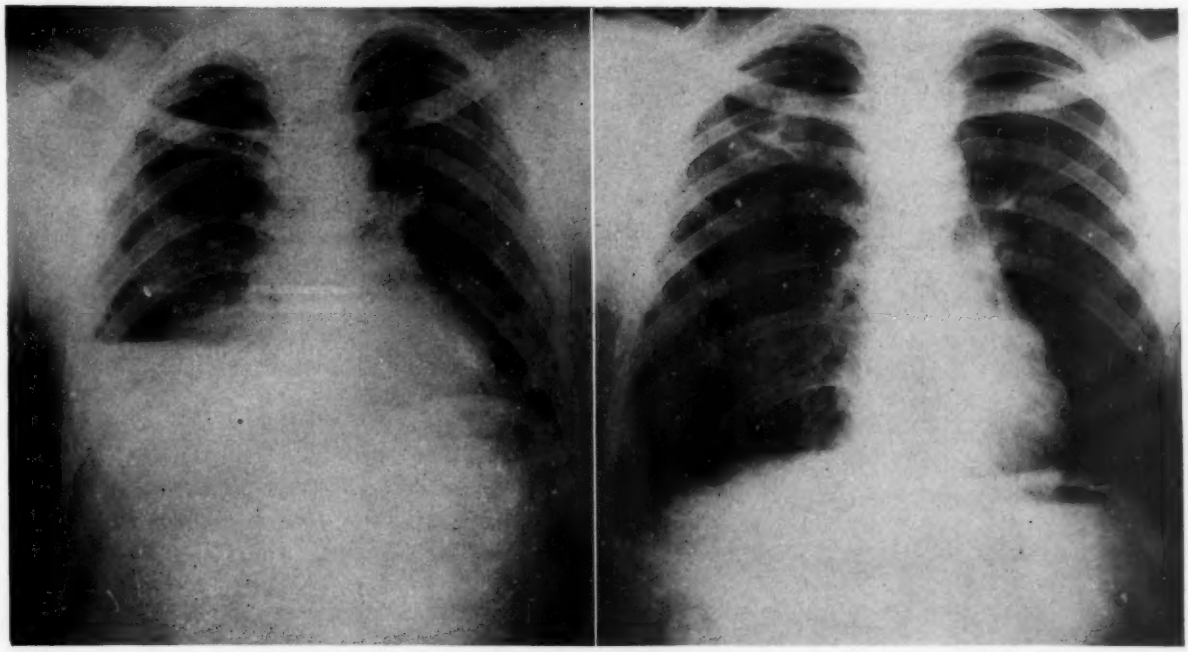


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FIG. 3. Case II. Knife wound of chest with a right hemopneumothorax with 75 per cent lung collapse; slight mediastinal shift to left; note horizontal fluid level.
FIG. 4. Case II. Lung has re-expanded to only 25 per cent collapse after two weeks; mediastinal shift is less.

right suprascapular region with moderate splinting of the whole right chest. A percussion note was hyper-resonant with absent breath sounds, voice sounds and tactile fremitus. Mediastinal dullness was shifted 5 cm. to the left of the midline. The point of maximum impulse was in the sixth intercostal space in the anterior axillary line. There was definite shifting of diaphragmatic dullness between horizontal and vertical positions of the patient. The blood count was normal.

The stab wound was sutured primarily and patient given an infusion of 1,000 cc. of normal saline, prophylactic doses of tetanus, penicillin and sulfadiazine. The original chest plate (Fig. 3) showed 75 per cent lung collapse with a free fluid level at the level of the fourth anterior rib. The original pain and dyspnea gradually disappeared on bed rest alone during the first few hours. A thoracentesis was done on the third day, removing 150 cc. of unclotted blood. (Fluid showed no organisms on smear or culture.) The patient remained comfortable and on the fourth day a chest film showed recession of fluid by two interspaces, however, no change in pneumothorax. Sutures were removed on the eighth day. On the tenth day a film (Fig. 4) showed 25 per cent increase of lung aeration and fluid occupying only the costophrenic angle. Tracheal and mediastinal shift were much less marked. During this time red cell count had gradually dropped from normal to 3.4 million. By the end of the third week no fluid was seen on the chest film and only 10 per cent lung collapse. The patient was discharged from the hospital on the twenty-fifth hospital day. The diagnosis was right hemopneumothorax.

CASE III. R. R. (No. 68569), a twenty year old colored male, was admitted to the surgical service on December 8, 1947, complaining of substernal pain following a stab wound of the left suprascapular region. Physical examination showed a well developed male with typical signs of shock. There was a 4 cm. laceration of the left suprascapular region with subcutaneous crepitation over the entire left posterior chest and upper axilla. Splinting of the whole left chest was present with absent breath sounds, voice sounds and tactile fremitus. A tympanitic note was heard over the region of laceration. Hemoglobin was 10 gm. and white cell count was 7,650.

Shock was controlled with 500 cc. of plasma. The wound was cleaned, irrigated and closed with interrupted sutures. Penicillin and tetanus toxoid were given. The original chest film showed only subcutaneous emphysema, no pneumothorax or effusion. On the third day a

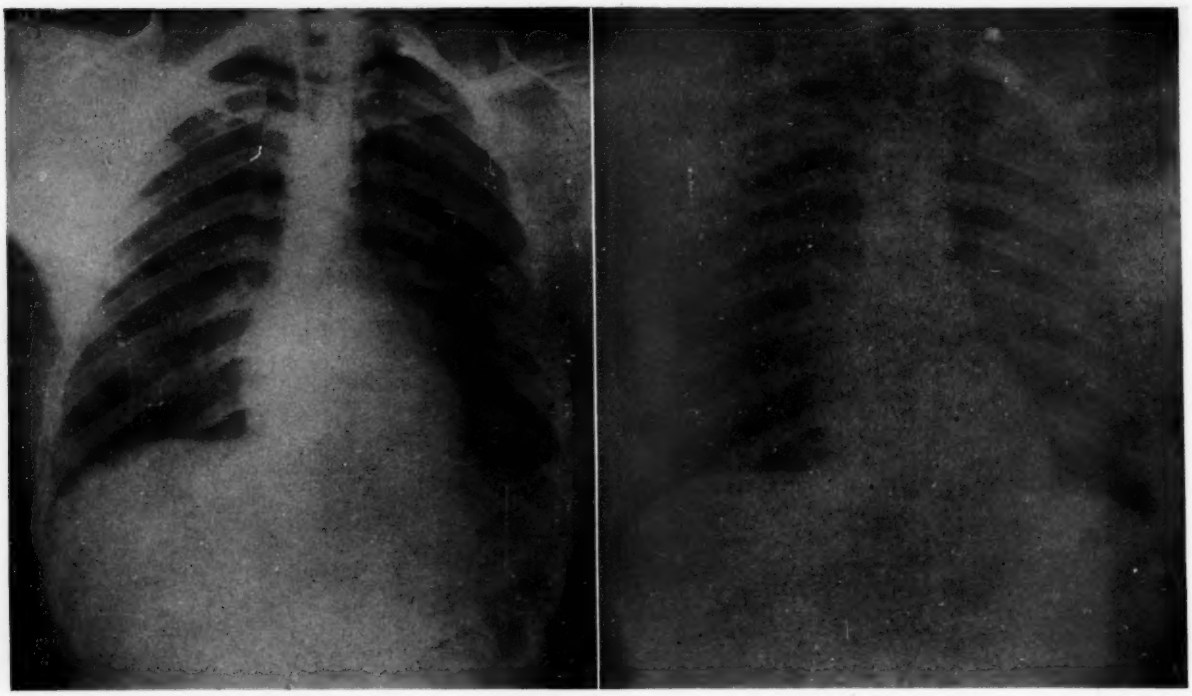

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FIG. 5. Case III. Knife wound of chest with left hemopneumothorax with 10 per cent lung collapse; fluid merely occupies the costophrenic angle; subcutaneous emphysema over left lateral chest wall and in left supraclavicular region.

FIG. 6. Case III. There has been complete re-expansion of lung after ten days with complete disappearance of fluid and subcutaneous emphysema.

plate shown in Figure 5 revealed the emphysema and a hemopneumothorax with a 5 to 10 per cent lung collapse and fluid occupying the costophrenic angle. By the eighth day the subcutaneous emphysema had disappeared and only slight pneumothorax was present which also completely disappeared by the twelfth day as noted in the radiograph. (Fig. 6.) The anemia present on admission steadily improved during the hospital stay, aided by ferrous sulfate, and was normal when the patient was discharged on the fifteenth day. The diagnosis was left hemopneumothorax with subcutaneous emphysema.

COMPLICATIONS

Complications may and do occur. Thoracentesis is carried out in the larger traumatic hemothoraces so as to reduce morbidity and complications, more especially fibrothorax and empyema.

Fibrothorax. In our cases it was found that the blood is absorbed before the establishment of sufficient fibrin forms over the pleural surface of the collapsed lung to prevent its re-expansion. However, the clotted hemothorax presents an excellent culture medium for further bacterial growth and total pyothorax may result. The surgical procedures instituted are decortication and in the more advanced stage thorocotomy with closed drainage. These, of course, are limited to the trained thoracic surgeon.

Early decortication (three to six weeks) of the clotted hemothorax and the removal of the infected fibrinous masses allows for re-expansion of the lung, decrease of chest deformity and healing of the empyema. Re-expansion was complete within twenty-four hours in 64 per cent of the cases.[19] Decortication after the "peel" is well organized is a dangerous procedure as multiple lung perforations may occur. Fibrosis incident to laceration of lung requires a long convalescence for return to normal as is evident from serial x-ray studies.

Empyema. War case reports showed an incidence of empyema of 21 per cent in hemothorax; however, none were seen in our series. It is heralded in with the usual signs of sepsis: temperature rise 100.5°F. (picket fence elevations) and increased white cell count. Thoracotomy with closed drainage is the method of

choice in dealing with this condition. In a series of 189 patients requiring thoracotomy 82.7 per cent healed and required no second operation when done with drainage; 56.5 per cent healed requiring no second operation when performed without drainage. Between 45 to 70 per cent of hemothoraces completely healed in four to six weeks following surgery.[13,18]

Subcutaneous Emphysema. Emphysema of the subcutaneous tissues may be a complication to penetrating wounds following thoracic trauma and suggests a lacerated lung. The torn parietal and visceral pleura and the lacerated lung parenchyma allows air to pass from the injured lung into the subcutaneously lacerated soft tissues. The air may pass via the pleural cavity without an x-ray apparent pneumothorax in the early phase of the condition (Case III). Later x-ray examination may reveal pneumothorax. The air escapes from the lacerated lung on expiration into the pleural space and may be forced into the soft tissues by the expanding lung during inspiration.[17] Another explanation is that with a penetrating injury air may be sucked into the thoracic parietes from the exterior. Usually active therapy directed toward the controlling of the spread of emphysema is unnecessary as the process is self-limited and subsides spontaneously. However, in true mediastinal emphysema incision and drainage of the air may become necessary.

Hemorrhage. When there is profuse bleeding causing a marked loss of blood and shock, the intercostal or mammary arteries are usually lacerated. Ligation of these vessels and the institution of shock therapy with blood replacement by transfusion may be needed as an emergency procedure. If uncontrollable hemorrhage should persist, a thoracotomy is necessary. However, this arterial complication is seldom encountered in penetrating wounds and none occurred in our series.

Foreign Body. Removal of a foreign body is generally an elective procedure after the patient's condition has been stabilized. The foreign body (bullet) 1 to 1.5 cm. need not be removed unless it is in a vital location or if a bronchopleural fistula has resulted. The metal rarely causes an abscess.

Pneumonitis, lung abscess and *mediastinitis* are also infrequent complications met with in this condition.

Included in the surgeon's armamentarium besides thoracentesis, decortication and thoracotomy with closed drainage are bronchoscopy, postural drainage and breathing exercises all of which, when timely employed, make for an easier and more rapid convalescence.

In closing this discussion rather for completeness but more correctly associated with open (sucking) intrathoracic wounds, mention is made of the rare condition, tension pneumothorax. This is due to increasing pneumothorax causing compression of the large veins of the mediastinum interfering with return flow of blood to the heart. Finally, when hemopneumothorax causes lung collapse due to a rapid accumulation of pleural fluid perhaps as a result of a lacerated parenchymal blood vessel in conjunction with an intrathoracic wound, mediastinal shift may result in marked dyspnea and cyanosis. An extreme shift of mediastinum and/or displacement of apex beat demands immediate operation for relief of pressure symptoms.

SUMMARY

1. Penetrating (not open) wounds of the chest have been discussed.
2. The symptoms and signs of intrathoracic wounds have been tabulated.
3. Definitive treatment of penetrating wounds of the chest has been outlined.
4. A brief consideration of the complications incident to chest wounds has been considered.

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THOUGH very rare, primary cancer of the Fallopian tube can occasionally be diagnosed preoperatively. There is pelvic tumor, pain and vaginal discharge, a triad of common symptoms not in the least pathognomonic. A yellowish, watery or amber-colored discharge is more suggestive of this diagnosis. The pain, moreover, is often colicky and may radiate to one thigh. Cytologic examination of the discharge may show cancer cells. Yet we cannot say it is a primary cancer of a Fallopian tube. Often an inflammatory reaction surrounds the site of the tubal malignancy. Even after radical surgery the prognosis remains serious; only a few patients have lived more than five years after operation. Radical surgery is the therapy of choice—a panhysterectomy with removal of the pelvic lymph glands. Postoperative radiation may also prove of value, especially in radiosensitive growths. (*Richard A. Leonardo, M.D.*)

HYPOSPADIAS*

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SIXTY-TWO cases of hypospadias have been seen at Milwaukee Children's Hospital between 1924 and 1948. In sixteen cases operation was thought to be unnecessary or permission to operate was not granted. Forty-six patients underwent operations ranging from a meatotomy to multiple stage construction of a new urethra. We hope to evaluate the end results of the various methods of urethral construction used in this series.

Hypospadias is the most common congenital penile anomaly. Campbell states that one in every 1,100 new born males has some variety of hypospadias. He bases this figure on autopsy data taken from 12,280 children examined. C. K. Smith estimates that one child in 300 to 500 births is effected. Our records show that one patient in every 898 patients admitted to the hospital had hypospadias.

Information in the literature concerning the familial incidence of hypospadias is meager. Some writers suggest that it may be found in several members of a family. Moszkowicz states that a patient with this anomaly may also be the carrier of other congenital anomalies. Our records show three instances in which more than one member of the family was affected. In one family two brothers had the penile type of hypospadias. In another a pair of twins had the penile type. Four brothers were affected in the third family, one having the glandular type, two having the penile type and the other having the perineal type. All four of these brothers also had congenital bilateral ear deformities and congenital club feet.

Numerous varieties of hypospadias have been described depending upon the position of the urethral opening, but for the sake of simplicity they may all be fitted into one of three classes, as follows: (1) balanitic or glandular, in which the opening is at the glans; (2) penile, in which the opening is somewhere along the undersurface of the penile shaft in front of the normal position of the scrotum and (3) perineal, in which the opening is on the perineum, behind the normal scrotal position.

The incidence of the various types of hypospadias is inversely proportional to the degree of severity so that the glandular type is most common and the perineal type least common. Thompson reported a series of 100 cases in which he found 46 per cent glandular type, 28 per cent penile type, 14 per cent perineal type and 12 per cent with multiple openings.

Our series contained 32 per cent glandular type, 62 per cent penile type and 6 per cent perineal type. There were no cases with multiple openings recognized as such. It is believed that many more patients with the glandular type existed but were not admitted to the hospital because they did not require treatment.

Symptomatology. The symptoms of hypospadias depend upon the degree of malformation and upon the age of the patient. In general the milder degrees do not cause symptoms except in those instances in which there is such a small urethral opening that urination is difficult. In these cases a meatotomy is necessary. Those patients with glandular or penile type are usually able to void while standing and frequently do not realize that they have an anomaly unless it is pointed out to them. The patient with the perineal type is unable to void while standing. It is difficult for him to keep clean and he carries about an ever present odor of urine. He is humiliated by his difference from other children and is shunned by them because of the uriniferous odor.

In adults coitus and impregnation are possible in the glandular and penile types. In the perineal type this is not probable and the deformity may become the source of great mental distress.

Physical Findings. One of the most important components of hypospadias is the chordee caused by the fibrotic ventral band which extends from the urethral opening forward to the glans where the normal opening should be. This band represents the obliterated urethra and surrounding corpus spongiosum which should occupy that area. This fibrotic band is inelastic and does not grow with the penis. It acts like a

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bow string, pulling the glans down and bowing the penis ventrally. Wehrbein states that chordee, in some degree, is always present in hypospadias. Our records show that about 33 per cent of patients with hypospadias had severe chordee and that the degree of chordee did not depend upon the degree of hypospadias. Only one patient with the perineal type had severe chordee, and some mild penile cases had more chordee than more severe penile types. (Table I.)

TABLE I
PHYSICAL FINDINGS

	No. of Patients	Per cent
Chordee	21	33
Glandular	1	
Penile	19	
Perineal	1	
Meatus small	33	55
Meatus pin point		
Requiring meatotomy	20	32
Glandular	9	
Penile	10	
Perineal	1	

The urethral opening was small in 55 per cent of our cases and like a pin point in 32 per cent. There was no relationship between the size of the opening and the degree of hypospadias. About half of those requiring meatotomy were of the glandular type.

There is considerable redundancy of the foreskin in hypospadias. This associated malformation has been variously used by surgeons in the correction of the congenital chordee or during the formation of a urethral canal. Removal of this tissue by circumcision makes the repair of hypospadias more difficult. It has been pointed out repeatedly that *patients with hypospadias should never be circumcised.*

Associated Anomalies. Cryptorchidism may be associated with hypospadias. There were eight cases (13 per cent) in our series, five of which were bilateral and three unilateral. Barney states that the frequency of cryptorchidism in otherwise normal boys varies from 0.11 to 0.2 per cent and that the ratio of unilateral to bilateral involvement is about 12:1.

There was one case of ectopia of the testis in which both testes were found on one side in the inguinal canal. There were two patients with umbilical hernia and four with inguinal hernia in this series, one having an associated hydrocele.

Four brothers previously mentioned all had bilateral congenital ear deformities and bilateral congenital club feet in addition to their hypospadias. There was one patient with congenital heart disease who died. Autopsy revealed a patent interventricular septum and a patent foramen ovale.

TABLE II
TREATMENT

Type of Treatment	No. of Cases	Per cent
No operation deemed necessary or patient's family refused operation	16	26
Meatotomy only	10	16
First stage only; urethral construction to follow	5	8
Nove-Josserand operation	3	5
Duplay operation	3	5
Ombredanne operation	25	40

TREATMENT

The treatment of hypospadias resolves itself into two parts, namely, the correction of the chordee and the construction of a new urethral canal extending from the urethral opening to the glans. (Table II.)

In general no treatment is necessary for the glandular type. Campbell states, "attempts to 'pretty up' the end of the penis in these cases is indeed meddlesome surgery."

The proper time for surgical treatment is still a matter of controversy. Most writers agree that the chordee should be treated early, before the age of two or three years, to allow the penis to grow straight. The disagreement arises in choosing the time for urethral reconstruction. Some suggest that this operation should be performed just before puberty because the penis is too small before that time and the operation would be technically much more difficult if done earlier. Others state that the urethral reconstruction may be done within a few months after the straightening operation. We agree that the chordee should be corrected early and that subsequent operations may be done as soon as the tissue has softened enough to allow easy handling so that the malformation is entirely corrected before school age.

For any straightening operation to be suc-

cessful it must include dissection and excision of the obliterated fibrous bow string. Creevy states that the first attempt to straighten the penis was probably that of Mettauer of Virginia in 1842 when he divided the fibrous rudiment of the corpus spongiosum subcutaneously.

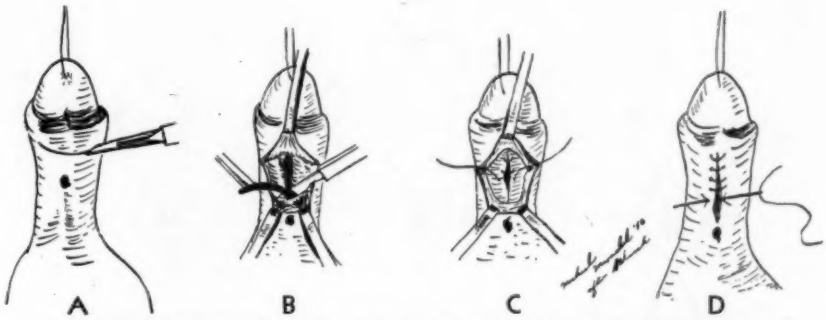

FIG. 1. Duplay's method of correcting the chordee modified from Cecil.[7]

In 1874 Duplay described the method of straightening the chordee which is still in use today. (Fig. 1.) He made a transverse incision across the ventral surface between the urethral opening and the glans (Fig. 1A) dissected out the fibrous band (Fig. 1B). In order to close the raw ventral surface which formed when the release of the band allowed the organ to straighten, he sutured the edges of the incision together longitudinally thus stretching skin from the sides and dorsum of the penis. (Fig. 1D.)

In operations subsequently described all include dissection of the fibrous band but differ in the manner in which the raw ventral surface is closed. Nesbit, Edmunds and Blair have described operations in which skin flaps made from the redundant foreskin were used to cover this defect.

Many operations have been designed to reconstruct the urethra. These can be divided into three groups, namely, construction of the urethra with tissue transplants, free skin tube grafts and skin flaps.

Tissue Transplants. Various tissues have been used in the reconstruction of the urethra but absorption, sloughing or contractures resulted in almost all cases and these methods have been largely abandoned. A few tissues used in these transplants were as follows: (1) veins, Tuffier (1899) and Leuen (1921); (2) ureter, Schmieden (1909); (3) appendix, Weitz (1915), Axhausen (1918) and McGuire (1927); (4) vaginal mucosa, Legueu (1918).

Free Skin Tube Grafts. Nove-Josserand first described the free skin tube graft method of treating hypospadias in 1897. Since that time it has been modified in various ways. Nove-Josserand constructed the urethra in two stages. (Fig. 2.) The first stage consisted of forming a subcutaneous tunnel at the site of the proposed urethra by pushing a trocar through from the urethral opening to the tip of the glans (Fig. 2B) and introducing a probe covered with a free skin tube graft into the tunnel (Fig. 2C) in order to form a skin lining for the new urethra, the skin being fastened around the probe or catheter in the form of a tube with the raw surface outward. The probe was withdrawn in about eight days, leaving the urethral lining in place. The new urethra was connected to the old urethral opening in a second operation.

McIndoe's modification in 1937 consisted of introducing the free skin tube graft into the new urethral tunnel wrapped around a catheter and leaving the catheter in place for ten days. Then it was replaced with a permanent dilator which was left in place for three to six months to prevent the contracture and stricture which were reported to take place with Nove-Josserand's original method.

The latest modification is the one-stage procedure of Young and Benjamin in which the new urethra is connected to the old opening during the first operation. In this method a perineal urethrostomy is used to prevent the urine from soiling the suture lines.

Three patients have been treated with the Nove-Josserand method at Milwaukee Children's Hospital. Two were of the penile type and one was of the perineal type. The patient with the perineal type had been previously circumcised. This patient was found to have a right inguinal hernia, right hydrocele and an ectopia of the testis with both testes in the right inguinal canal. The hernia and hydrocele on the right were repaired and an exploratory

operation done on the left side to confirm the absence of a left testis. A Nove-Josserand operation was done during the fourth hospital stay and four more operations were necessary to connect the urethra and close subsequent fistulas. Follow-up on this patient five years after the last hospitalization and ten years after the Nove-Josserand operation revealed the urethral opening to be ½ cm. proximal to the glans. He was sixteen years old and was satisfied with the result. There was no chordee or difficulty in urination.

Skin Flaps. Operations making use of skin flaps are divided into two groups, namely, those utilizing penile skin from alongside the proposed urethral site to form the urethra, and those utilizing skin from the scrotum and ventral side of penis proximal to the urethral opening.

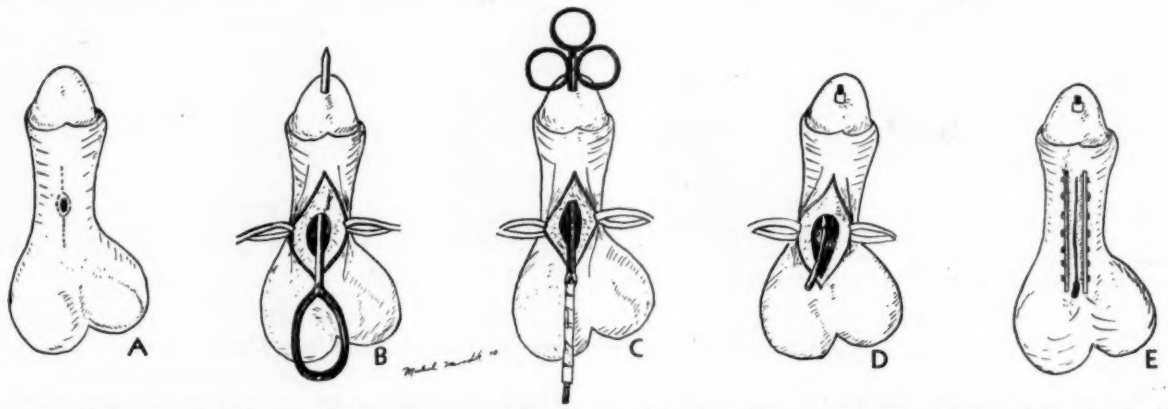

FIG. 2. Nove-Josserand method of construction of urethra with free graft modified from Young and Benjamin.[37]

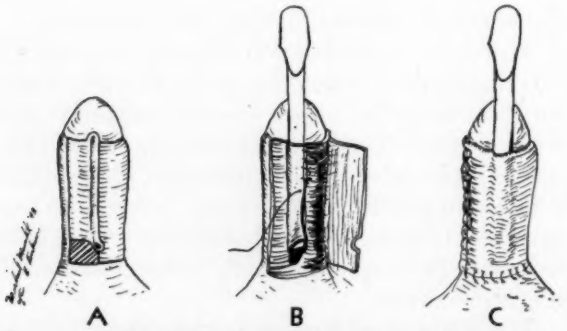

FIG. 3. Thiersch-Cecil modification of the Duplay urethroplasty from Creevey.[9]

One of the two patients with the penile type was also circumcised. A Nove-Josserand operation was done three years ago, ending in a slough of part of the graft. The slough was repaired six months later and sloughed again. Follow-up on this patient revealed that the urethral opening was at its original position and that the patient would return to Milwaukee Children's Hospital for further plastic repairs.

The third patient developed a fistula after the first attempt at connecting the urethra to the old opening. Attempts to contact this patient for follow-up examination were unsuccessful.

Duplay proposed using the skin from the ventral side of the penis to form the new urethra and accomplished this by making two parallel incisions on either side of the ventral midline. After undermining flaps in both directions of each incision he sutured the two middle flaps about a catheter to form the urethral tube and then pulled the lateral flaps in to cover the raw ventral surface and sutured their edges together. He connected the new urethra with the old opening at a subsequent operation. The suture line of the new urethra and the ventral skin were superimposed on each other and many fistulas resulted.

Several writers[5,8,9] have advocated the method described by Thiersch for the treatment of epispadias to prevent the formation of fistulas. In this operation (Fig. 3) the parallel skin incisions were staggered at different distances from the ventral midline thus preventing the suture lines from lying directly over each other.

Numerous writers have described methods for covering the raw ventral surface of the penis after the urethra has been formed by Duplay's method. Previously prepared tube jump grafts from the scrotum and prepuce[15,30,35] or pedicle flap grafts[3,31] were used.

Three patients have been treated using the Duplay-Thiersch-Cecil method at Milwaukee Children's Hospital. In two cases the operation was done twenty years ago. In one a perineal type, when the patient was last seen the open-

ing was still at the perineum and there was still considerable downward curving. This patient was twenty-four years old and married but had no children. In the second case, a penile type, when the patient was last seen the opening was still at the middle of the penile shaft and there was considerable chordee. In the third case, a perineal type, the urethral opening was at the glans and the penis was straight. There had been no difficulty and the patient was satisfied with the result.

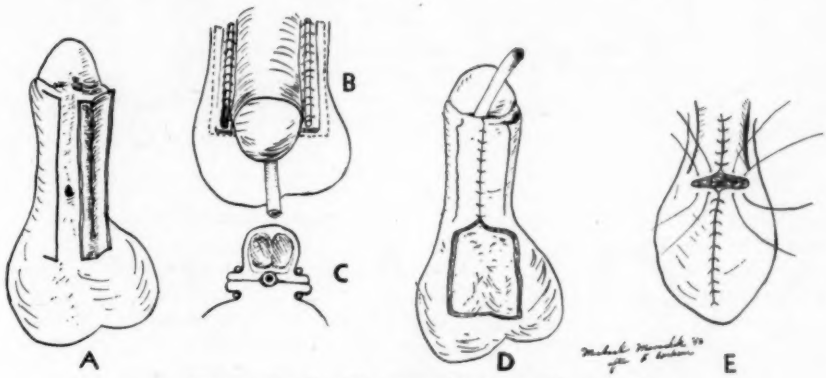

FIG. 4. Bucknall's operation from Creevey.[9]

The operations of Bucknall and Ombredanne utilize the skin behind the meatus in the formation of the urethral floor.

Bucknall in 1907 sutured the ventral surface of the penis down to the anterior scrotal surface (Fig. 4B and C) after making parallel incisions on each side of the meatus from the glans down onto the scrotum (Fig. 4A). The penis was dissected free from the scrotum at a second operation (Fig. 4D) leaving the scrotal surface attached as the floor of the urethra and pulling together the free edges to cover the raw surface (Fig. 4E). Hair frequently grew on the scrotal skin used to form the urethral floor and urinary salts were deposited there forming stones.

Cabot and Cecil (1931 to 1936) modified this operation by forming the urethral floor from non-hair-bearing skin on the ventral of the penis in the manner of Duplay and then burying the raw ventral penile surface into a trough in the scrotum, dissecting it free at a second operation as Bucknall described.

Neither the Bucknall operation nor its modification has been used at Milwaukee Children's Hospital.

Ombredanne Operation. In 1923 Ombredanne described a three-stage operation designed to eliminate indwelling catheter, urethrostomy and cystostomy.

The first stage consisted of straightening the chordee in the same manner as was first described by Duplay in 1874. (Fig. 1.)

The second stage has been referred to as the pouch operation[16] (Fig. 5) because the urethra resembles a purse-string pouch. The periphery of the pouch was outlined by placing a purse-string on the ventral surface of the penis in an oblong pattern with the urethral meatus in its center. (Fig. 5A.) The suture extended onto the glans and for a sufficient distance toward the perineum so that the proximal flap behind the meatus was the same length as the distal flap from the glans to the meatus. The width of the oblong flap should be about one-third the circumference of the penis. The proximal flap was dissected free leaving the purse-string in place at its outer edge, being careful not to injure the underlying urethra. (Fig. 5B to D.) A catheter was usually put into the urethra to outline it and guard against injury to it. The lateral edges of the distal flap were dissected free leaving the base, which would eventually form the dorsal part of the urethra, in place to insure a blood supply to the pouch. The width of this area should be about one-fourth the circumference of the penis. The purse-string was then pulled tight and tied (Fig. 5D) forming a new urethral opening at the glans.

The raw ventral surface was then covered with a flap constructed from the foreskin by holding it up like a hood and splitting it (Fig. 5E), starting with an incision on the mucosal surface at the corona of the glans thus lengthening the foreskin and producing one raw surface on the side next to the glans. A Y-shaped incision was made into the foreskin to form a

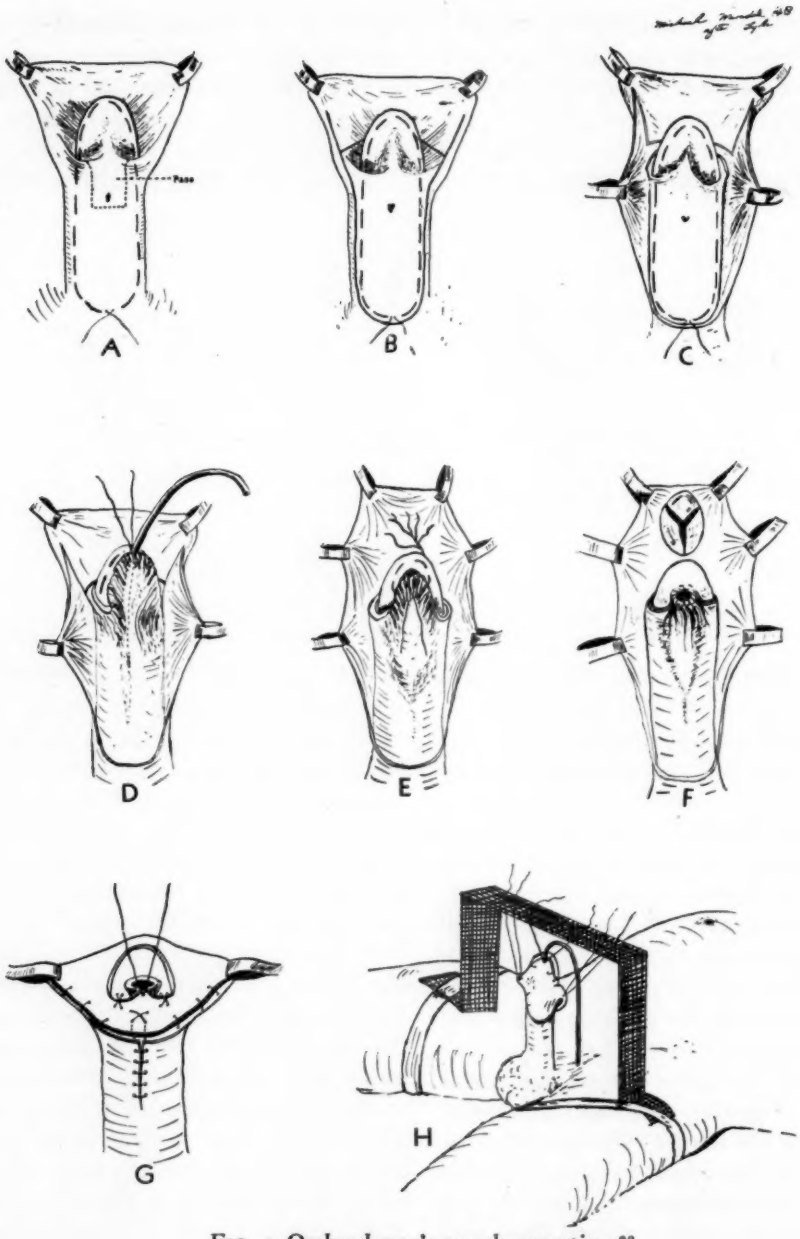

FIG. 5. Ombredanne's pouch operation.[28]

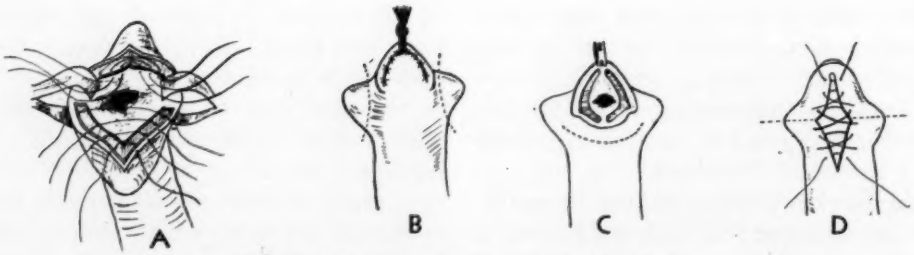

FIG. 6. Advancement of ventral tubercle.[28]

button hole at the level of the glans. (Fig. 5F.) The glans was then passed through the button hole so that the raw surface of the foreskin covered the raw ventral penile surface. (Fig. 5G.) The foreskin flap was held in place with interrupted sutures around the glans and at the tudinal incision (Fig. 6D) and the skin edges are sutured together in that position.

FOLLOW-UP

Several writers[14,16,19,24] have reported favorable results with the Ombredanne operation,

TABLE III
OMBREDANNE OPERATION (THIRD STAGE)

Present Age (yr.)	Years Postoperatively	Comment	Follow-up
22	8	Repeated 3rd stage	Result satisfactory
22	11	.....	Result satisfactory
22	13	.....	Result satisfactory
21	9	.....	Meatus large; slight spray
20	12	Repeated 3rd stage; has had 9 operations; previously circumcised (abdominal tunnel graft to cover ventrum)	Result satisfactory
18	2		Meatus still large; spray
17	7		Opening on shaft at glans; spray
16	13	.....	Result satisfactory
15	7	.....	Result satisfactory
14	5	.....	Result satisfactory
13	6	Previously circumcised (flaps from side to cover ventrum)	Result satisfactory
13	7	Perineal type	Meatus large; spray
9	5	Previously circumcised (sliding grafts from sides to cover ventrum)	Result satisfactory
8	3	.....	Result satisfactory
7	3	.....	Result satisfactory
6	4	.....	Result satisfactory
6	In hospital	.....	Result satisfactory
5	3	.....	Result satisfactory
5	3	.....	One side of meatus large; spray
5	3	Repeated 3rd stage	Result satisfactory
4	2	Repeated 3rd stage	Result satisfactory
3	2	.....	One side of meatus large Voids to one side; spray
3	2	.....	Result satisfactory
3	2	.....	Result satisfactory
2	1	.....	Result satisfactory

periphery of the flap. The ventral flap was usually large and the meatus was shaped like a fish mouth after the second stage. (Fig. 6A.)

The third stage was designed to advance this ventral tubercle onto the glans by making an incision on each side of the gaping meatus along the edge to produce a raw area which could be sutured together on each side to reduce the size of the meatus. (Fig. 6A and B.) In some instances the ventral tubercle cannot be advanced onto the glans and a transverse incision (Fig. 6C) must be made below the urethral opening to allow the skin of the tubercle to be shift up to the glans. When the tubercle is sutured to the glans, this incision is transposed into a longi-

their postoperative observation extending over various periods of time.

Twenty-five patients with hypospadias have been treated at Milwaukee Children's Hospital with the three-stage Ombredanne operation.

The average age for the first stage, in which the chordee was corrected and the meatus enlarged when necessary, was five years and the average length of hospital stay was nine days. The average age for the second or pouch stage was five plus years and the average length of hospital stay was eighteen days. The average interval between the first and second stages was nine months. The third stage was usually done at six years, with the hospital stay averaging

eleven days. Again the average interval between the second and third stages was nine months.

It is our impression that *all three stages should be completed before school age* and that the stages may be done at intervals of six to twelve months, this period being determined by the softness of the skin scar from the previous stage.

Of the twenty-five patients treated with the Ombredanne method, four were operated upon more than ten years ago, eight were operated upon between five and ten years ago and thirteen have been operated upon in the past five years. Their ages ranged between two and twenty-two years. (Table III.)

Follow up information has been collected on all of these patients. All of those that were available were asked to come to the hospital for check-up examinations. Information was secured from those who were not available for examination by means of form letters. All patients indicated that they were well satisfied with the results. The chordee was relieved in all cases and the penis remained straight during erection. The urethral opening remained at the glans in all but one case and in this case the opening was just short of the glans. This patient had been circumcised previously and it was necessary to cover the raw ventral surface with an abdominal tunnel graft instead of the foreskin flap. Two other patients had also been circumcised previously. The raw ventral surface in both of these cases was covered by pulling in the skin edges from the sides. In six cases the meatus was either large or at the side of the midline resulting in a spray during voiding. The rest voided in a solid stream. There were no cases in which hair had grown in the urethra. In five cases the third stage had to be repeated to bring the urethral opening onto the glans. One patient was operated upon nine times, each operation resulting in some sloughing. He is one of those with a large meatus caused by one side sloughing after the last operation.

SUMMARY

1. Sixty-two cases of hypospadias have been seen at Milwaukee Children's Hospital between 1924 and 1948.

2. Associated anomalies such as cryptorchidism were frequently found.

3. Forty-six patients underwent operations ranging from a meatotomy to multiple stage construction of a new urethra.

4. An evaluation of the end result of the various operations used to construct a new urethra is given.

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The operation of vaginal hysterectomy often requires more skill than the usual abdominal supravaginal procedure but it has many advantages and surgeons ought to perform it more often, in my opinion. It is often an ideal operation for vaginal prolapse, especially when the uterus is also diseased. Some prefer to keep the supposedly healthy uterus and perform a Manchester operation instead, in cases of uterine prolapse. However, results are excellent with vaginal hysterectomy when properly done and if the surgeon makes sure to anchor firmly the uterosacral and other pelvic ligaments to the vault of the vagina so that a vaginal enterocele will not occur. Besides, there is very little shock connected with this operation and the operative mortality is less than one-fourth of 1 per cent. Even a large fibroid uterus can be removed vaginally although it may be necessary to bisect the uterus longitudinally and take out half at a time in some instances; yet results are excellent. I think we should be less hesitant to perform this operation. (*Richard A. Leonardo, M.D.*)

INTRINSIC LESIONS OF THE STOMACH*

A REVIEW OF 458 CASES

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FROM 1936 to 1946 a total of 711 gastric resections were performed in the surgical department of the Cook County Hospital. Of this group, 458 cases were performed for intrinsic lesions of the stomach. Our analysis will be confined to the latter group.

TABLE I
INTRINSIC LESIONS OF THE STOMACH

Type of Lesion	No. of Cases	Percentage
Benign gastric ulcer	214	46.7
Carcinoma of stomach	223	48.6
Lymphosarcoma	3	0.65
Polyp with malignant changes	3	0.65
Syphilitic gastritis	3	0.65
Leiomyoma	2	0.43
Polyps	2	0.43
Reticulum cell sarcoma	2	0.43
Submucous fibroma	2	0.43
Carcinoma and fibroma	1	0.21
Neurofibroma	1	0.21
Lipoma	1	0.21
Lymphatic leukemia	1	0.21
Total	458	100.00

In this series of 458 cases, 214 or 64.7 per cent were peptic ulcers of the stomach. (Table I.) The race incidence was noted in 192 cases and the distribution was found to be 80 per cent in the white race, 18.2 per cent in the Negro race and 1.04 per cent in the yellow race. As to the distribution between men and women, 185 or 86 per cent were found in the former, and twenty-nine or 14 per cent in the latter, a ratio of 6:1. This finding is in keeping with the sex incidence of peptic ulcer when we consider the ratio of essential lesions as found at autopsy by Portis and Jaffe.[1]

In regard to the distribution of gastric ulcers according to age (Table II, Fig. 1) the greatest number was found between the fourth and seventh decades in which a total of 174 cases or 82.1 per cent was encountered. Six cases or 2.8 per cent were found in the second to the third decade, and three cases or 1.4 per cent were found between the eighth and ninth decades. The youngest patient on which resection for gastric ulcer was performed was twenty-four years of age and the oldest was eighty-three years of age.

TABLE II
AGE DISTRIBUTION IN CASES OF PEPTIC ULCER

Age (yr.)	No. of Cases	Percentage
21–30	6	2.8
31–40	24	11.2
41–50	54	25.2
51–60	76	35.5
61–70	46	21.4
71–80	5	2.3
81–90	3	1.4
Total	214	100.00

Multiple ulcers were encountered in twenty-three cases, eighteen having two ulcers, two having three ulcers and three having four ulcers. The latter two groups showed ulcers which were subacute in character. The size of the ulcer was found to vary considerably (Table III), ranging in size from 0.2 cm. to 8.0 cm. in diameter. The greatest majority, seventy-four cases or 31 per cent, ranged from 1.0 to 1.9 cm. in their greatest diameter. The gross appearance of the ulcer was uniformly characteristic, the proximal edge showing a gradual sloping margin, whereas the distal edge was steep and occasionally overhanging.

The mucous membrane was slightly reddened and edematous at the edge of the ulcer. The microscopic sections of the gastric ulcers showed the characteristic four layers as described by Askanazy,[2] namely, the exudative layer, necrotic layer, vascular granulation area and the underlying layer of dense fibrous connective

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tissue. In most instances, the latter layer, except for the few subacute peptic ulcers which we have encountered, had destroyed the muscularis propria. The site of 237 ulcers was noted. The greatest number (214) were found along the lesser curvature. (Table IV.)

TABLE III
SIZE OF GASTRIC ULCERS

Size (cm.)	No. of Ulcers	Percentage
0.2 to 0.9	62	25.3
1.0 to 1.9	76	31.0
2.0 to 2.9	39	15.9
3.0 to 3.9	33	13.4
4.0 to 4.9	15	6.1
5.0 to 5.9	6	2.4
6.0 to 6.9	1	0.4
7.0 to 7.9	0	0.0
8.0 to 8.9	3	1.2
Unknown	10	4.0
Total	245	100.00

TABLE IV
SITE OF GASTRIC ULCERS

Site	No. of Ulcers	Percentage
Lesser curvature	214	87.3
Greater curvature	12	7.8
Anterior wall	3	1.2
Posterior wall	8	3.2
Unknown	8	3.2
Total	245	100.00

In our series of 214 gastric ulcers which we have examined there were only two cases which presented evidence of carcinoma arising from a pre-existing peptic ulcer, giving us an incidence of only 0.9 per cent. This is in keeping with the findings of Portis and Jaffe,[1] Crohn[3] and Abrahamson and Hinton.[4] In the two cases of peptic ulcer with carcinomatous changes which we have observed, these changes occurred along the edge of the ulcer, with extension into the adjacent submucosa and dense stroma of the existing peptic ulcer. Both ulcers were located along the lesser curvature, one having a defect measuring 4.5 by 3.5 cm. and the other a defect measuring 2.8 cm. in diameter. In the latter case there was evidence of the carcinoma arising independently of the ulcer, in view of the fact that multicentric carcinomatous changes were noted in the mucous membrane at a considerable distance from the ulcer. These malignant changes were noted in two males aged seventy-four and sixty-nine, respectively. Two hundred twenty-three patients or 48.6 per cent were resected for gastric carcinoma, and of this group, 184 patients or 82 per cent were males and thirty-nine or 18 per cent were females, a ratio of 4.5:1. The race incidence was noted in 183 cases, 75 per cent occurring in the white race, 24 per cent in the Negro race and 1 per cent in the yellow race.

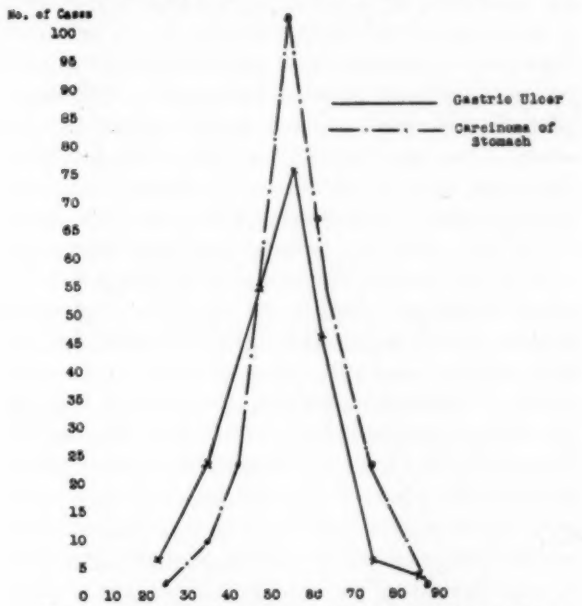

FIG. 1. Age group expressed in ten-year periods.

TABLE V
AGE DISTRIBUTION IN CARCINOMA OF THE STOMACH

Age (yr.)	No. of Cases	Percentage
21–30	2	0.9
31–40	9	4.0
41–50	22	9.8
51–60	101	45.0
61–70	66	30.0
71–80	22	9.8
81–90	1	0.4
Total	223	100.00

The age distribution is summarized in Table V, the youngest being twenty-eight and the oldest eighty-five years of age. The greatest incidence was noted in the fifth decade in which 101 or 45 per cent were listed. (Fig. 1.)

Histologically, the type of carcinoma encountered was chiefly that of adenocarcinoma. This was noted in 203 cases or 91 per cent. Scirrhous carcinoma ranked second in frequence, with eleven cases or 5.4 per cent. Medullary carcinoma was third with six cases, an incidence of 3 per cent; finally, there were three cases of colloid carcinoma or 1.4 per cent. The gross appearance of the malignant tumors of the stomach was unfortunately not completely described in forty-nine cases. In 179 cases, however, the diffuse ulcerating infiltrating type was noted in 162 patients and the polypoid form was observed in seventeen cases.

Of the remaining twenty-one examined cases of intrinsic lesions of the stomach, the following were described (Table 1): syphilitic gastritis three cases; lymphosarcoma three cases; reticulum cell sarcoma two cases; fibroma two cases; adenocarcinoma with fibroma one case; benign glandular polyps of the stomach two cases; polyps of the stomach with malignant changes three cases; leiomyoma two cases; fibrosarcoma one case, and neurofibroma one case. This series of twenty-one cases represents a group of unusual lesions of the stomach which are seldom encountered but which have to be considered in the differential diagnosis of gastric ulcers and malignancy.

COMMENTS

It is apparent from the above study, that gastric surgery for intrinsic lesions of the stomach concerns itself mainly with the removal of the gastric ulcers and carcinomas. In our series the number of cases of each type is almost equal. It is obvious then that the preoperative identification of the nature of the lesion is not as important as the need of resection for the relief of persistent symptoms of gastric ulcer or carcinoma. We are in agreement with the opinion of Bockus[5] who believes that the important problem of clinicians is not how often the gastric ulcer becomes malignant but whether an ulcerating lesion of the stomach is benign or malignant. In our series only 0.9 per cent of the ulcers resected revealed evidence of carcinomatous tissue at the edge of the ulcer, and of the two cases one suggests a dual lesion, that of peptic ulcer of the stomach and primary carcinoma of the stomach starting from multicentric foci.

It is interesting to note that in our series of five cases of polyps of the stomach, three showed evidence of malignant changes. One can say, therefore, that polyps of the stomach are a more serious lesion since they more readily develop malignant changes. Of the remaining twenty-one cases described here the incidence is too low for any interpretive value, except to say that they are to be considered in the differential diagnosis of intrinsic gastric lesions.

CONCLUSION

A survey of 458 intrinsic lesions of the stomach was made, the majority of which were either carcinoma or gastric ulcer. The pathologic differentiation of these lesions was noted. The incidence of the changes of a carcinoma developing in a gastric ulcer was 0.9 per cent and does not indicate a reason, in our opinion, for radical gastric surgery, for fear of malignant changes in a chronic ulcer but for the indications of gastric ulcer *per se*.

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PHYSIOPSYCHOLOGIC TREATMENT FOR POSTOPERATIVE URINARY RETENTION

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FOR many years surgeons have slighted the care of the urinary tract in the postoperative patient. Much too frequently and definitely too routinely, orders for catheterization were written which did not reflect sound clinical judgment based on physiopsychologic facts. Many controversies exist throughout the literature on this subject. The two most outstanding are whether to employ pharmacologic or psychologic methods of treatment to promote postoperative urination and, should these treatments fail, when to catheterize the patient. At St. Mary's of Nazareth Hospital we made a statistical survey of 2,000 consecutive operations in the hope of resolving these problems.

Postoperative urinary retention may be defined as inability of the postoperative patient to void in spite of a full bladder, normal kidney function and in the absence of organic obstruction. Using this accepted definition we compiled statistics on 1,000 consecutive surgical patients. We then formulated a method of treatment which we employed in the next 1,000 cases. The first set of statistics was compiled without the awareness of the nurses, house staff or physicians because we did not desire any change from the postoperative urinary tract management already in existence. The second set, however, was compiled with the awareness of all since a standard method of treatment carefully and routinely employed was found to be necessary.

The 2,000 patients were in the middle class, mainly of Polish and Italian extraction, of both sexes and between the ages of three days to seventy-two years. They were operated upon by seventy-four different surgeons. The preoperative treatment in the majority of the elective operations consisted of a barbiturate and an enema the night before, and no breakfast and a premedication of morphine and atropine the morning of surgery. The operative anesthetic in 1,900 of the patients was pentothal sodium® supplemented by the gases and curare when necessary. The operative technics were variable and depended upon each surgeon. Postoperative treatment was fairly routine after such operations as those for appendixes, hernias, hemorrhoids and pilonidal cysts. It was only after the more severe operations that blood, intravenous fluids, chemotherapy, gastrointestinal suction and intravenous proteins and vitamins were employed.

The incidence of catheterization in the first 1,000 patients was 18.3 per cent (excluding 6 per cent in whom a retention catheter was inserted). Notice the nearness of our percentages to that of Jordan's published in 1933 (Table 1) despite the use of the various drugs discovered in the thirteen-year interim for the treatment of postoperative urinary retention. Because of this we turned from the consideration of a pharmacologic approach to a physiopsychologic one.

Primarily, we determined the time at which the bladder contained sufficient urine to promote urination. The average postoperative patient voided 330 cc. of urine in fourteen hours; this was a kidney excretion rate of 23.5 cc. per hour. Compare this with 41 to 75 cc. per hour quoted by Best and Taylor for the average male, and understand the suppression of urinary excretion existing in the patient one day postoperatively, based on age, weight, sex, height, posture, humidity, temperature, diet, fluid intake and output, anesthetic, degree of narcosis and mental excitement. We knew that 250 to 300 cc. are needed in the average male as a stimulus for urination. Therefore, we set a fourteen-hour limit, at the end of which the average postoperative patient would have enough urine so that he could void; otherwise, physiopsychologic treatment would have to be employed. However, any patient would be catheterized who complained of bladder pain or in whom the bladder was palpable abdominally at any time that first day.

TREATMENT

In 1928 Sachs upheld strongly the psychologic approach to postoperative urinary retention; in 1944 McLaughlin and Brown definitely

showed that postoperative urinary retention was psychologic in the young males in their series.

We believed with Lozinski that the patients should be requested to urinate in the recumbent position preoperatively in order to overcome any existing psychologic block. To aid him in doing so, we added that as complete privacy as possible should be achieved by means of drapes, screens and closed doors.

Postoperatively, we requested that a urinal or bedpan be within the reach of each patient and that the patient not be requested to urinate or asked if he had urinated at any time before the fourteen hours had elapsed. This prevented him from becoming conscious of the urinary mechanism before he was actually able to void. All patients were divided into three groups, namely, those who urinated before fourteen hours, those who tried to urinate and failed and those who made no attempt at all to urinate. The first group of patients needed no treatment. The second group was to be reassured by the nurse that there was insufficient urine in the bladder at this time. The patients were referred to the house staff at the expiration of the fourteen hours. The third group also was referred at that time.

The interne evaluated in each patient all the factors influencing his kidney excretion rate and decided if there was a sufficient amount of urine present in the bladder. If there was a sufficient amount present, the patient was requested to urinate. If he failed to do so, the interne and the nurse, supervised by the resident, continued the physiopsychologic treatment employed so occasionally and haphazardly before.

We had practiced early rising sporadically since 1945, but now we employed it routinely in those cases in which the patients did not void. This consisted of using a sitting position for the female with the feet braced on a chair at the side of the bed and the standing position for the male, duplicating the body posture each had employed in previous years for urination. More important were the reassurances to the patient of his ability to void, the impossibility of his wound breaking open, the necessity for sustained downward pressure and the fact that he would have to "break through" in a gradual manner. The first indication of success came when the patient felt the urge to urinate but could not go beyond a certain point. One or two more words of reassurance, the use of psychologic "tricks" such as running water, drinking water, playing with ice chips, supplemented by a hot water bottle to relax the tense perineum, and the patient voided.

Remember that this treatment was not employed until we thought the patient had sufficient urine in the bladder. If this treatment failed, we allowed four hours to elapse and then tried again. The patient was catheterized only in the event of bladder discomfort or if the bladder was palpable or percussable abdominally.

Since the first statistics showed that the percentage of urinary retention was negligible in all ages below thirteen, and in thyroid, head, neck and extremity surgery the treatment was not therein specified. An outline of this treat-

TABLE 1
PERCENTAGE DROPS IN CATHETERIZATION

Type of Operation	1933	1946			1947		
	Per Cent Catheterized	No. Patients	No Catheterized	Per Cent Catheterized	No. Patients	No. Catheterized	Per Cent Catheterized
Appendix	19.8	385	73	20.0	290	4	1.4
Gallbladder	15.8	67	9	13.0	62	1	1.6
Hernia	15.7	99	26	25.0	108	4	3.7
Hermorrhoid	14.3	64	17	25.5	70	2	2.8
Gastric	37.5	21	1	4.7	16	1	6.0
Breast	7.8	15	1	6.0	21	0	0.0
Thyroid	4.0	23	1	4.0	23	0	0.0
Major abdomen	12.7	45	6	13.0	43	0	0.0
Pilonidal cyst	....	20	5	25.5	9	0	0.0

ment was placed in each chart room and lectures were given the house and nursing staffs so that everyone understood the applied physiology and psychology.

RESULTS

The percentage of patients catheterized dropped from 18.3 per cent to 1.7 per cent with the employment of the physiopsychologic treatment. Refer to Table 1 for the percentage drops in the various kinds of surgery. Only 46 per cent of the patients voided without being asked before fourteen hours, while the other 39 per cent were treated. None of the patients developed any urinary tract infection or dysfunction noted in the hospital or as reported subsequently by the family physician; this was so even though we had calculated after Taussig that there was a 13 cc. residual per hour in the bladder of the voiding patient.

The seventeen patients who did not void had only one factor in common; they were all neurotic. Five of these patients had previous surgery and catheterizations which fixed a pattern in their minds to which they rigidly adhered, and out of which there was not enough time to condition them. One was a deaf mute to whom we could not converse. Another had prostatism which definitely convinced him after his operation for hemorrhoids in that region that he could not void.

COMMENT

We achieved a postoperative catheterization rate of 1.7 per cent without the incidence of urinary tract infection or dysfunction and without the use of drug therapy. Had we also employed a drug, could we not have mistaken the excellent results for the work of the drug? And might not this have happened already in many of the drugs described as valuable in this condition?

The first 1,000 cases led us to believe with Jordan that postoperative urinary retention depended upon vegetative imbalance, mechanical interference with Bauchpresser and the psychic makeup of the patient. Now we recognize only the third factor. Boland also describes such factors as age, sex, duration of the operation, type and site of the operation and type of anesthesia. These factors do influence the urinary excretion rate producing a suppression of urinary excretion. Therefore, when a surgeon orders his patient catheterized on the eighth hour and only 160 cc. of urine are obtained, the patient should not be listed as having postoperative urinary retention but physiologic postoperative urinary suppression.

The results on 1,000 patients showed that 98.3 per cent of all patients seen in the average surgical service, who did not have direct operations on the urinary tract and who voided prior to surgery, voided after surgery. No urinary tract infection or dysfunction developed in those patients as a result of the treatment. Therefore, we suggest discontinuing postoperative catheterizations, except in direct urinary tract surgery and in those patients in whom the psychologic factor is too strong for the short time and kind of treatment available. As more and more work appears on this condition and as the surgeon learns to cooperate with the psychiatrist, as suggested by Blanton and Kirk, so will the condition known as postoperative urinary retention fade from the lists of the common postoperative complications of surgery.

SUMMARY

1. Statistics were compiled on 1,000 unselected consecutive surgical patients with an incidence of catheterization postoperatively of 18.3 per cent.

2. Physiopsychologic treatment was instituted.

3. The incidence of catheterization dropped to 1.7 per cent.

4. In any hospital, in the average run of surgical patients, the incidence of postoperative urinary catheterization depends upon the knowledge of the surgeons and house staff of the physiologic and psychologic facts involved.

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ACUTE DIVERTICULITIS OF THE LARGE BOWEL*

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ACUTE diverticulitis has been a rather rare disease at the Henry Ford Hospital. In a registration of approximately 500,000 only ninety-four patients with acute diverticulitis have been indexed. This gives a ratio of roughly 1 in 5,000 which is comparable, more or less, to the incidence of acute pancreatitis, namely, 1 in 7,000 as reported by Fallis[1] from the same but somewhat fewer registrations. In contrasting this with a much more common entity, namely acute appendicitis, the occurrence of this latter disease was diagnosed thirty-eight times as often in the same registration.

Etiology. Acute diverticulitis of the colon arises as a complication of diverticulosis. A solitary diverticulum is usually congenital while multiple diverticula are of sporadic origin. The latter develop in the following manner:

It is generally accepted that "the point of vascular penetration through the musculature of the bowel wall constitutes a point of weakness. General factors influencing the health of the individual, or tending toward loss of muscle tone may increase the divarication of muscle fibers at this point. Fatty infiltration may also play part as may chronic constipation or spastic colitis with either of which gaseous distension is of common occurrence. No single factor can explain the origin of acquired diverticula in the colon, and it is much more likely that the process results from a summation of these several factors."[2]

Diverticula frequently insinuate themselves into an appendices epiploica since here the peritoneum surrounds the appendices epiploica and is not directly applied to the bowel wall at this point.

Wierda[3] has been able to produce one or more diverticula of the colon in each of three rats fed a high diet for ninety weeks or longer. He concluded that the regularity of their position and the similarity in their walls seemed to indicate a uniform response to given conditions. These diverticula were produced in the most tortuous part of the colon, which in the rat is that part near the cecum.

In reviewing solitary diverticulitis of the cecum and ascending colon, Carroll[4] believed that fecoliths were important in the etiology since they were demonstrated to be present in 76 per cent of forty-four such cases reported. Certainly, with obstruction of the neck of the diverticulum by a fecolith, conditions would be at the optimum for causing secondary inflammatory changes in the diverticulum and surrounding tissues.

Table 1
AGE INCIDENCE BY SEXES

Decade	Total	Percentage
1	0	0.0
2	0	0.0
3	5	5.3
4	7	7.5
5	16	17.0
6	40	42.5
7	20	21.3
8	4	4.3
9	2	2.1
	94	100.0

Age and Sex Incidence. As shown in Table 1, acute diverticulitis is predominately a disease of middle age, for 80 per cent of the patients were in the fifth, sixth and seventh decades or between the ages of forty and seventy, and of this number, one-half were in the fifty to sixty age group. This observation coincides with that of Jackman and Buie[5] of the Mayo Clinic who found the average age of 400 patients with diverticulosis was fifty-six years. The ratio of male to female was approximately 2:1, there being sixty-four males (68.1 per cent) and thirty females (31.9 per cent) in the group of ninety-four patients. This finding bears out Poate's[2] assertion that 60 per cent of the cases of diverticula occur in males and that surgical complications double in the male.

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DIAGNOSIS

History of Previous Colon Disturbances. Thirty patients had similar previous episodes; thus a little over one-third gave clues as to their diagnosis by repetition of attacks. Of this group, five had mild similar illnesses, two patients had two previous attacks and four recalled three episodes each.

Nineteen patients (20.2 per cent) had positive evidence of diverticula preceding their attack of diverticulitis. It is evident, therefore, that more than one-fifth of the patients had diverticula prior to the acute episode. Certainly one negative examination with barium enema should not rule out the presence of diverticula. The use of the new drug, tetraethylammonium chloride,* which diminishes bowel spasticity may be of value by making possible more accurate demonstration of diverticula. Geddes[6] observed that of the patients who exhibited diverticulosis by x-ray, 15 per cent developed inflammatory changes.

A history of constipation or so-called chronic irritable colon was obtained in fifty-five instances (58.3 per cent). Rankin and Grimes[7] found that 40 per cent of their patients complained of constipation alternating with an occasional spell of diarrhea. Constipation obviously attracts attention to the colon and, with other of the common factors, should arouse suspicion of diverticulitis. Fourteen per cent of the patients admitted taking cathartics regularly.

Chief Complaint. On admission, pain, fever and bloating were the common complaints.

Fevers. All patients exhibited temperature elevations varying from 99° to 105.6°F. The range is outlined in Table II in which it is shown that in three-quarters of the patients the temperature was above 100°F. In approximately two-thirds of the patients whose temperature ranged above 102°F. complications such as generalized peritonitis or abscess formation developed.

Abdominal Distention. Although bloating, belching of gas and passage of flatus was a constant complaint, abdominal distention was pronounced in only fifty-eight patients (61.7 per cent). This finding varied with the severity of the disease. Increase in distention is usually indicative of abscess formation or spreading peritonitis. The initial distention is due to gas in the large intestine proximal to the spastic area of involvement, but later in the disease pronounced distention may be associated with localized ileus of adjacent loops of small intestine from localized or spreading peritonitis. Infrequently, subacute obstruction of the colon occurs from tumefaction of the involved area of the colon and, more rarely still, complete obstruction may supervene. It is of the utmost importance to estimate accurately by means of repeated scout x-ray films of the abdomen the source of the obstructive manifestation. Relief from distention of the small intestine may be expected from the use of the Miller-Abbott tube, but transverse colostomy or cecostomy may be necessary to relieve the more advanced stages of large bowel obstruction. Unnecessary operations may be avoided by careful differentiation for decompression of the large intestine has no place in the treatment of small intestine ileus.

TABLE II
MAXIMUM TEMPERATURES

Temperature	Patients	Per Cent of Total
98.6°–99.8°F.	25	26.5
100.°–101.8°F.	50	53.0
102.°–103.8°F.	15	15.9
104.°F. plus	4	4.6

Pain. Pain is usually referred to the left lower quadrant directly over the lesion; but if the proximal colon is distended, the intensity of the distress may occur in the right lower quadrant from over distention of the cecum. This feature may mask the real condition and confuse the issue to the point that a diagnosis of acute appendicitis is made, as occurred in five of ninety-four patients although a total of eight patients had pain and tenderness in the right lower quadrant.

Muscle Spasm and Tenderness. Muscle spasm with localized tenderness was noted in approximately one-half of the patients. Since the sigmoid colon is the portion most frequently involved, tenderness and rigidity are commonly found in the left lower quadrant. These findings are indicative of peritoneal irritation and are dependent on the pathologic process at the time of examination. A change in the area or degree of intensity is of value in estimating the progress

* Furnished as etamon chloride by the Department of Clinical Investigation, Parke, Davis & Co., Detroit, Mich.

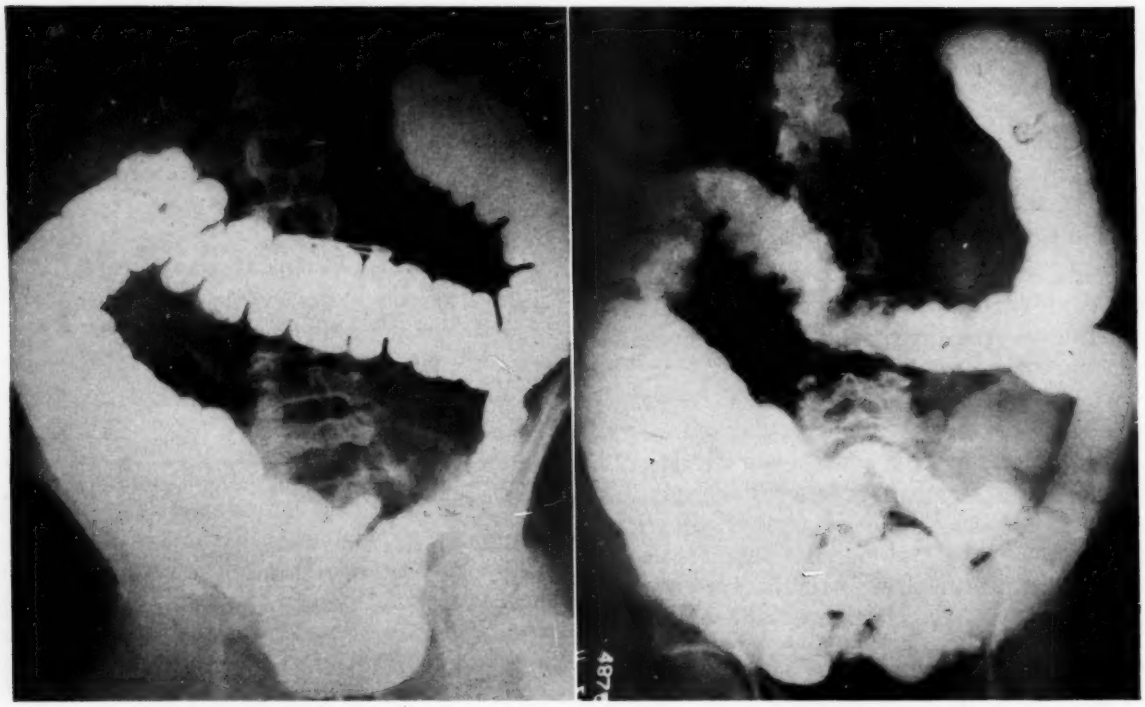

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FIG. 1. Shows spasm of sigmoid but no diverticulosis.
FIG. 2. Spasm relieved and diverticula clearly demonstrated after administration of etamon chloride.

of the disease. Rupture of a diverticulum into the free peritoneal cavity is indicated by a diffuse spread of muscle spasm while a decrease in localized tenderness shows that resolution is taking place.

Hemorrhage. Gross blood is rare in diverticulitis although two patients in the series were admitted after severe and almost exsanguinating hemorrhages. Both recovered and have remained well following resection of the involved area of colon. Occult blood in the stool is common in our experience. It is just as frequent in diverticulitis as in carcinoma and thus is of little diagnostic significance.

Laboratory Findings. Blood in the stools is included here, as most of the time it was microscopic in character. In only two instances of this series was the evidence of hemorrhage so gross as to attract attention, and this was a severe hemorrhage. Thirty-nine (41.3 per cent) of these people exhibited blood in their stools.

The red blood count varied between 2.9 million and 6.5 million; the over-all average was 4.44 million per cu. mm. It so happened that in four other cases in which the diagnosis of diverticulitis or malignancy was considered, all of which proved to be solely malignancy of the large bowel, the red count was not altered to such an extent to contribute in any way to the diagnosis. The white blood counts fluctuated from 6,300 to 25,800, the average being 14,600. The higher counts were observed in the complicated cases with abscess formation, peritonitis and/or intestinal obstruction. The polymorphonuclear neutrophiles averaged 83 per cent, ranging between 50 and 96 per cent of the total white counts. Here again, the patients who presented complications with the diverticulitis had the increased percentage of neutrophiles in their differential counts.

X-ray Examination. Approximately 20 per cent of the patients in this series had previous evidence of diverticula by x-ray examination, and it is probable that repeated films would have shown diverticula in some cases in which one examination had been negative.

In the presence of spasm of the colon we have used etamon chloride, one of the newer drugs, to relieve spasm prior to a repeat barium enema. This elimination of spasm opens the orifice of the sacculation allowing the barium to enter. Figure 1 shows a marked amount of spasm in the sigmoid and descending colon, but no diverticula in a patient suspected of having diverticulosis. Figure 2 illustrates the results of the barium enema obtained the morning following

the administration of 10 cc. of tetraethylammonium chloride. Note the marked diminution of spasm and how apparent the diverticuli have become. Further investigation in the use of etamon chloride is being carried out. It is believed that this drug should prove to be of considerable help in the differentiation of inflammatory lesions and neoplastic lesions of the colon although as yet we have no success to record. The usual practice is to wait until the acute phase of the disease has subsided before using the diagnostic barium enema, but it may be that we have been overly cautious in this respect. In a recent patient treated conservatively the local manifestations of the disease appeared to subside but fever persisted. A carefully administered barium enema revealed the reason for the fever: an abscess cavity was found communicating with the sigmoid colon. (Fig. 3.) The abscess had formed between the layers of the mesosigmoid and had then evacuated itself back into the bowel. Transverse colostomy promptly relieved the symptoms and subsequently the sigmoid colon was resected. We have previously reported a similar case.[8] Internal fistulas, except colovesical fistulas in which the opening is usually small, have likewise been demonstrated. There is some evidence that barium has a beneficial effect on the diverticula since it is not uncommon for patients to claim that they feel better after barium enemas, an observation that should induce the obtaining of frequent progress films.

X-ray may be of value in differentiating between diverticulitis and malignancy. The following points are helpful: (1) Carcinoma and diverticulitis may coexist. Therefore, the presence of diverticula does not rule out cancer. (2) Obstruction, complete or subacute, is more likely to occur with carcinoma than with diverticulitis. (3) Destruction of mucosa suggests carcinoma. Heaping up of mucosa is more indicative of diverticulitis. (4) Ballooning of the rectum is a sign of carcinoma. Spasm of the rectum is a sign of diverticulitis. Etamon chloride intramuscularly may be of help in differentiation by eliminating spasm which in turn allows more accurate appraisal of the mucosal pattern.

Sigmoidoscopic Examination. Visualization of the rectum and sigmoid should be carried out in all suspected cases although the examination may have to be deferred during the height of the attack. Sigmoidoscopic examination is the best safeguard against overlooking a malignancy. In the acute or subacute phase little positive evidence is obtainable. Indirect evidence such as the passage of mucus, spasm of the sigmoid or inability to advance the instrument owing to inflammatory fixation is the usual finding. When the disease is quiescent, it is often possible to visualize the mouths of the diverticula.

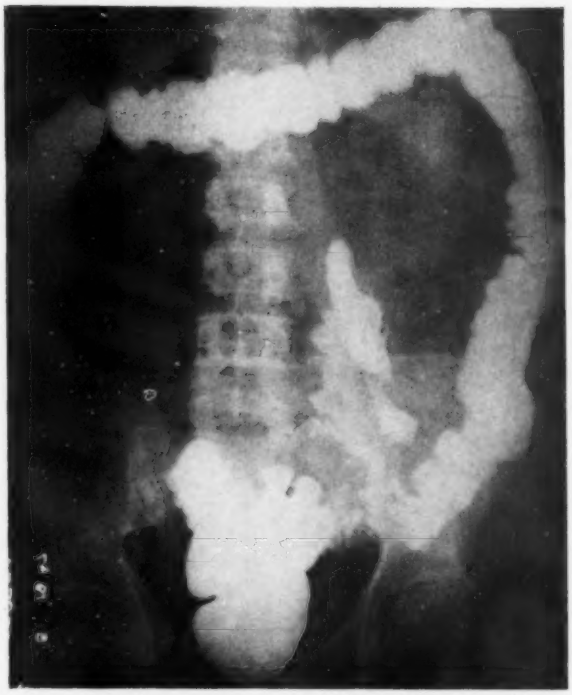

FIG. 3. Pericolic abscess complicating acute diverticulitis.

A tentative diagnosis of acute diverticulitis may be made when confronted with a middle aged, overweight patient complaining of fever, bloating and the gradual onset of pain in the lower abdomen, usually more pronounced in the left. Additional evidence is furnished by a history of previous similar colon disturbance, especially if there has been roentgen evidence of diverticula. All of the patients in this series with known diverticula when the diagnosis of diverticulitis was considered were subsequently proven to have been suffering from the disease on the basis of either operation or positive x-ray findings. Muscle spasm and tenderness in the lower half of the abdomen, more particularly on the left, plus a temperature elevation of 100° to 102°F. with a leukocytosis of 12,000 to 15,000 and polymorphonuclear leukocytes of 80 per cent plus, provide confirmatory diagnostic evidence.

DIFFERENTIAL DIAGNOSIS

Acute Appendicitis. Diverticulitis occurring in long sigmoid loops may present maximum point of tenderness in the midline or even the right lower quadrant. Also distention of the cecum secondary to obstruction lower down due to diverticulitis draws attention of both the patient and medical attendant to the appendix region. In five of our ninety-four patients (5.3 per cent) an erroneous diagnosis of acute appendicitis was made and the true state of affairs was revealed only by laparotomy. It should be helpful to recall that appendicitis occurs in the younger group of patients, vomiting is constant, the pain is generalized at first and finally localized in the right lower quadrant, and a bowel movement or passage of flatus seldom benefits the patient while in acute diverticulitis great relief is experienced.

Carcinoma of the Colon. Differentiation here is often extremely difficult even after the abdomen is opened. In favor of carcinoma is a history of good health with no previous colon difficulty, loss of weight and blood in the stools. Moreover, colon distention is more likely to occur with carcinoma than with diverticulitis. In this series of patients none on medical management was subsequently found to have had a concomitant malignancy. However, during the period of the study, of those patients not included in the series in whom the diagnosis was in doubt, all proved to have carcinoma at operation. Laparotomy is definitely indicated when there is any question of malignancy; and if at operation there is still doubt, resection of the involved segment is clearly indicated.

Pelvic Inflammatory Disease. One patient operated upon with a diagnosis of tubo-ovarian abscess was found to be suffering from acute diverticulitis. Exteriorization of the mass followed with a Mikulicz resection and subsequent closure of the colostomy effected a cure.

TREATMENT

The treatment of acute diverticulitis is primarily medical. Surgical intervention is indicated only for the complications of the disease. Of the ninety-four patients in this series, medical treatment only was given to sixty-one patients (65 per cent), with five deaths, a mortality of 8.2 per cent; surgical treatment was carried out in thirty-three patients (35 per cent), with two deaths, a mortality rate of 6.1 per cent. The over-all mortality was 7.2 per cent. Medical management of acute diverticulitis consists of general supportive measures such as bed rest, maintenance of fluid balance and correction of anemia plus use of the indwelling Levine tube to relieve nausea and hot stupes to alleviate abdominal distress, and nutrition maintenance by a bland, low residue diet supplemented when necessary with intravenous glucose and amino acids. The gastrointestinal tract is well lubricated by 1 ounce of liquid petrolatum given three times a day, and cleansing is aided by oil retention enemas followed with hot saline enemas run in slowly by the gravity method only. It is difficult to evaluate the use of the sulfonamide group in this series, for only nine patients received these drugs and only one patient had penicillin administered. On the foregoing regimen fifty-six of the sixty-one patients (91.8 per cent) treated medically recovered from the attack. There were five deaths in this group of patients who did not receive surgical treatment although all had perforations with generalized or localized peritonitis. Of this number, three were admitted to the hospital *in extremis*, all dying within twenty-four hours of admission; and although all were candidates for surgery, none was in condition for operation. The other two patients might have been saved by surgical intervention, but in one conservative measures were used persistently because of erroneous diagnosis and in the other permission for operation was refused by the patient's family.

The indications for surgical intervention during the acute phase are perforation, as evidenced by the onset of generalized or localized peritonitis, and obstruction, acute or subacute. After the acute phase has subsided, surgery is required for the cure of hemorrhage, external or internal fistulas and when the suspicion of carcinoma can be clearly removed only by exploration.

Colostomy was performed on fifteen patients, of which two had peritoneal drainage. In addition one of these died with autopsy findings of multiple intraperitoneal abscesses indicating that the operation had been done too late or that the drainage was inadequate. Peritoneal drainage was done without colostomy on eleven patients, in nine instances for localized abscess and in two for generalized peritonitis, with one death in the latter group within twenty-four hours of operation. Exteriorization of the in-

volved area of colon was the method of surgical treatment in six patients, all of whom recovered. All patients recovered after abdominal exploration, at which time neither colostomy or drainage was done. Fifteen of this group of thirty-three patients subsequently had the involved segment of colon successfully removed, nine by resection and anastomosis following colostomy, and six by the Mikulicz technic.

The over-all mortality for the thirty-three patients subjected to surgical intervention during the acute phase of the disease was two deaths or 6.1 per cent. With the possible exception of one patient with generalized peritonitis who died within twenty-four hours of abdominal drainage, no patient died because his treatment was surgical.

COMMENTS

On the basis of the results of treatment in this group of cases, the evidence is strongly in favor of transverse colostomy as the treatment of choice when surgical intervention is indicated. No patient died because this operation was performed; in certain of the fatal cases under medical management the patient might have recovered if colostomy had been done earlier in the disease.

The decision as to whether abdominal drainage should supplement the colostomy is a difficult one. There can be no doubt that localized abscesses and cases of generalized peritonitis should be drained although penicillin and streptomycin undoubtedly will reduce the number of occasions in which drainage is required. When drainage is indicated, it is important to introduce the drains to the depth of the pelvis.

Removal of the involved segment is required for the treatment of chronic obstruction, hemorrhage and internal and external fistula. Multiple stage resections should always be done. The procedure of resection and anastomosis three to six months after preliminary colostomy is preferable to the Mikulicz or exteriorization type of operation.

SUMMARY

1. A series of ninety-four cases of acute diverticulitis of the large bowel is presented and analyzed.

2. Obstructive manifestations in acute diverticulitis may be due to associated small intestinal ileus.

3. The use of etamon chloride as an aid for x-ray study of the colon is introduced; elimination of muscle spasm in visualizing diverticula and the potential assistance in differentiating between inflammatory lesions and neoplastic lesions of the colon are described.

4. Surgical intervention during the acute phase is indicated for the complications of perforation and obstruction.

5. Transverse colostomy is the operation of choice.

6. When drainage is indicated, the pelvic cul de sac should be included in the regions drained.

7. When the diagnosis of carcinoma is doubtful, laparotomy is clearly indicated after the acute attack has subsided.

8. Resection of the involved area should be done only on the defunctioned colon.

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CHLOROPHYLL AND WOUND HEALING*

EXPERIMENTAL AND CLINICAL STUDY

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THE literature contains several reports which state that preparations of chlorophyll are probably of value in the management of healing wounds and in the treatment of certain surgical infections. These papers have come chiefly from two centers. Four of them were from Bern, Switzerland (Bürgi[1–3] and Boehringer[4]). In this country most of the published work has been done by a number of investigators at Temple University (Gruskin,[5] Ridpath,[6] and Smith et al.[7–10]). Several other authors have reported clinical observations on the use of chlorophyll ointments in the treatment of roentgen burns, chronic ulcers and oral sepsis.[11–14]

In wound-healing experiments with animals in which chlorophyll ointments have been compared with a presumably inert control the chlorophyll has sometimes exhibited a slight advantage. In Bürgi's first paper on the subject he presented a protocol of what he called a typical experiment on rabbits. A wound 2 cm. in diameter on the animal's back was healed at the end of ten days while the so-called control wound treated with unguentolan, a preparation containing the oil soluble vitamins, was unhealed. Photographs of seven wounds treated with chlorophyll and their corresponding controls were included in the paper, but the quality of the photography was such that one is not convinced that the chlorophyll was effective in bringing about an earlier *complete* epithelization of the experimental wounds. In 1942 we[5] reported guinea pig experiments in which we tested the effect of a number of substances on the healing of cutaneous wounds. One of these substances was an ointment consisting of an oil-soluble chlorophyll derivative in a lanolin base. In a small series of twelve animals there was an apparent acceleration of healing in four, seven showed no effect and in one there was apparent delay.

Smith and Livingston[9] reported more favorable results using a water-soluble chlorophyll derivative in a hydrophilic jelly base. In twenty-four animals (six rats, six guinea pigs, six rabbits and six dogs) there was an apparent acceleration of healing in 75 per cent of the wounds and no instance of delay. Combining these results with those obtained with other preparations (alkaline solution, acid solution, lanolin ointment and cholesterol ointment), they found evidence of acceleration in 67 per cent of 112 animals tested. Similar experiments in which the wounds had been contaminated with broth cultures of Staphylococcus aureus and Streptococcus hemolyticus showed apparent acceleration in 63 per cent of eighty-six wounds in guinea pigs and dogs. Small third degree burns were produced on dogs. In 120 lesions there was acceleration of healing in 71 per cent. It is of interest that they reported, "The skin sloughs off in four to five days, leaving a clean-based, circular ulcerating area." Since this is less than half the time required for the sloughing of an untreated, *dry* third degree burn in the dog,[16,17] the authors seem to have unwittingly demonstrated the effectiveness of wet dressings and hydrophilic ointments in slough separation.

The most recent and most interesting work of Smith and Livingston[10] is that in which several chemotherapeutic agents were combined with chlorophyll and tested on experimentally infected wounds in guinea pigs and dogs. Fifty-eight lesions in the guinea pig treated with plain chlorophyll ointment healed in an average of 14.3 days while the combination ointment gave an average healing time of 10.6 days in eight animals. Carboxy-sulfathiazole did just as well (11 days) and four other sulfonamides produced healing in about 13.5 days. The healing time with the antibacterial agents alone was about 15 days. One bit of datum is not supplied with the published paper, namely, the time re-

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quired for the healing of such a wound when it is treated with the ointment base or with nothing at all. This figure could not be obtained from the original paper[9] because no healing times in days were given. It is possible that these wounds were contaminated but not seriously infected.

The experiments with chlorophyll to be reported herein were of four types: (1) observations on the healing of cutaneous wounds in the guinea pig, (2) observations on the healing of dermatome donor sites in humans, (3) use of chlorophyll in the treatment of clinical burns and (4) use of chlorophyll in the treatment of indolent surgical wounds and ulcers.

ANIMAL EXPERIMENTS

The guinea pig experiments were carried out according to the technic previously used by us.[15] Two small symmetrical wounds were made on the abdominal wall of the animal. The test ointment was placed on the left while the other wound was dressed with dry gauze only and served as a control. Dressings were done every two days until both wounds were healed and a record of the size of the wounds was made by tracing their outlines on sterile cellophane.

Seven kinds of chlorophyll were tested. Dr. E. J. Miller of the Experiment Station of Michigan State College obtained the following for us:* (1) chlorophyll *b*, oil soluble, which was presumed to have the formula $C_{55}H_{70}O_6N_4Mg$ (experiments previously reported[15]), (2) sodium magnesium chlorophyllin ($C_{34}H_{31}O_6N_4MgNa$), (3) sodium copper chlorophyllin ($C_{34}H_{31}O_6N_4CuNa_3$), (4) a variety designated as chlorophyll x and (5) a variety designated as chlorophyll 5x. A part of the animal experiments and all of the clinical tests were carried out on two kinds of chlorophyll ointment.† These were chlorophyll *a* (6) in a hydrophilic jelly base and (7) in a carbowax base.

Table 1 shows the results from testing chlorophyll *a* in the hydrophilic jelly base on twenty-four guinea pigs. The best case for chlorophyll in our work is in this group of experiments. According to the criteria of the experiment there was apparent acceleration of healing in 34.7 per cent of the animals. However, in only four animals (17 per cent) was the difference more than one dressing period (two days). The twenty-three control wounds were healed in an average of 10.2 days, and the wounds treated with chlorophyll were healed in an average of nine days. The significance of a difference of only slightly more than a day in this small series is questionable. (Fig. 1.)

The results obtained in the experiments with seven kinds of chlorophyll ointment using seventy-eight guinea pigs are summarized in Table II. This indicates a slight advantage for chlorophyll because 29 per cent of the series showed some apparent acceleration of healing. However, when the individual records are examined, it is found that the difference in healing times of the two wounds is seldom more than one dressing period. Presumably, if chlorophyll had a definite therapeutic effect, it would exert this favorable influence on the test wounds more than a third of the time. Nevertheless, the favorable trend encouraged us to

TABLE 1
WOUND HEALING EXPERIMENTS ON GUINEA PIGS, USING CHLOROPHYLL *a*

Number	Days before Healing		Apparent Effect of Chlorophyll
	Control Wound	Treated Wound	
1	8	8	No effect
2	8	8	No effect
3	8	8	No effect
4	10	6	Accelerated
5	8	6	Accelerated
6	10	10	No effect
7	8	8	No effect
8	10	6	Accelerated
9	10	6	Accelerated
10	10	10	No effect
11	8	8	No effect
12	..	..	Died after 3rd dressing; wounds the same size
13	10	10	No effect
14	12	10	Accelerated
15	10	10	No effect
16	12	12	No effect
17	12	12	No effect
18	12	10	No effect
19	10	10	No effect
20	14	8	Accelerated
21	10	10	No effect
22	10	10	No effect
23	12	10	Accelerated
24	12	10	Accelerated
Averages	10.2	9	Acceleration in 34.7%

* Supplied by the American Chlorophyll Company.
† Supplied by the Rystan Company, New York.

FIG. 1. Example of wound-healing experiment on the guinea pig (animal No. 8, Table 1); the wound treated with chlorophyll healed (arrow) while the control remained unhealed for four days.

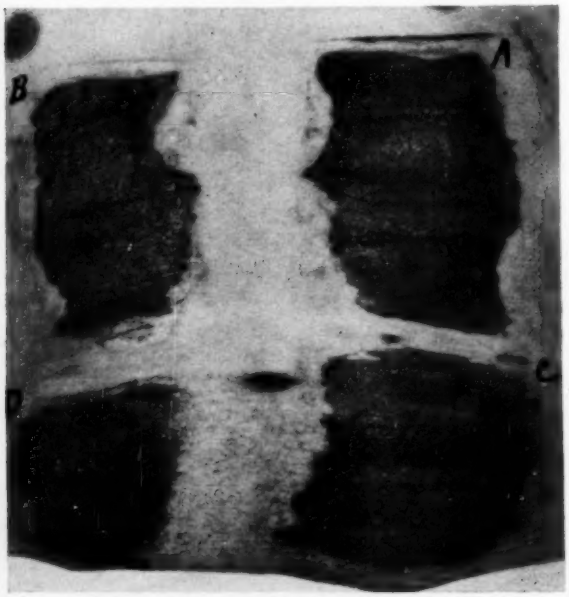


FIG. 2. Dermatome graft site experiment; area A, treated with chlorophyll; B, plain jelly base; C, vaseline gauze; D, plain gauze. Healing progressed at the same rate under each of the four dressings.

try chlorophyll preparations in other types of wound-healing experiments.

DERMATOME GRAFT SITE EXPERIMENTS

This type of experiment was carried out in five patients. Curiously enough, when vaseline gauze was used to cover the control wound, there were several instances when the chlorophyll side healed first. When the control side was treated with plain hydrophilic jelly base or simply plain fine mesh gauze, there was never any difference in the healing times of the treated and control wounds. The end point of a typical experiment is shown in Figure 2. The donor sites under chlorophyll jelly, plain jelly base, vaseline gauze and fine mesh gauze were all healed in the same period of time (ten days).

TABLE II

NUMBER OF ANIMALS IN WHICH HEALING WAS HASTENED, UNAFFECTED OR DELAYED, WITH USE OF VARIOUS PREPARATIONS OF CHLOROPHYLL

Kind of Chlorophyll	Hastened	No Effect	Delayed	Summary
Chlorophyll *b*	4	7	1	No effect
Na Mg Chlorophyll	3	6	3	No effect
Na Cu Chlorophyll	1	5	0	No effect
Chlorophyll x	1	4	1	No effect
Chlorophyll 5x	3	3	0	Acceleration (?)
Chlorophyll *a* (hydrophilic)	8	15	0	Acceleration (?)
Chlorophyll *a* (carbowax)	3	5	4	No effect
Totals	23	45	9	Acceleration (?)

CHLOROPHYLL IN CLINICAL BURNS

Nine patients with burns were treated with the chlorophyll *a* ointment in the hydrophilic jelly base. Seven of these had minor burns, one had a moderately severe burn and one patient was severely burned. Following are brief case reports of the minor cases:

CASE I. J. S., a white male aged forty-four, received a steam burn of the anterior chest on October 12, 1943. There was a superficial second degree burn with some blistering. Chlorophyll ointment was applied three times, with healing in ten days.

CASE II. G. P., a white female aged one year, received superficial second degree burns of the chest, right arm and neck on October 23, 1943. These were dressed three times with chlorophyll ointment and pressure dressing. The patient was hospitalized seven days. The wounds healed in eighteen days.

CASE III. E. C., a white male aged twelve, received a flame burn of the right leg, a moderately deep second degree burn. It was dressed four times with chlorophyll ointment and healed on the twentieth day. The wound looked rather raw on two occasions, and there was some complaint of pain.

CASE IV. M. R., a white female aged sixteen months, received a small second degree burn of the anterior chest on November 5, 1943. Chlorophyll ointment was applied once. The wound healed on November 18, 1943.

Case v. C. M., a white female aged three months, received a second degree burn of the foot on November 26, 1943. Chlorophyll ointment was applied. The burn healed on December 7, 1943.

Case vi. M. H., a white female aged forty-six, received second degree burns of the arms from a gas stove explosion. Chlorophyll ointment and a pressure dressing were applied. The wound healed in two weeks.

Case vii. J. T., a white male aged twenty-four, received deep second degree burn of back on December 18, 1943. A vaseline dressing was applied first but on the second day it was replaced with a chlorophyll dressing. The patient was discharged from the hospital in two days. He came back for several dressings, complaining bitterly of pain in the wound which always looked red and irritated. He did not return for the last dressing but it is presumed that the wound healed in several weeks.

Commenting on the cases of minor burns one could say that the chlorophyll ointment seemed to be a satisfactory dressing for most of the seven cases. However, it is well known that a superficial second degree burn will usually heal quite promptly regardless of what substance is put on it so long as that substance is not definitely detrimental to wound healing. There was some irritation in two of the cases. The case with the moderately severe burns is reported in more detail and some photographs are supplied because it represents a borderline case in which a stimulating or soothing ointment might have been expected to contribute something toward healing. Such was not the case.

Case viii. H. M., a male aged sixteen, was burned on January 7, 1944, when his gasoline-soaked trousers became ignited. He was admitted on that day with deep second and third degree burns of the left leg. Chlorophyll ointment under a pressure dressing was applied. On January 13th his temperature was 99.6°F. On January 15th the dressings were removed and the photograph shown in Figure 3 was taken. The area about the upper thigh was rather raw. Most of the vesicles were intact. Chlorophyll dressings were replaced. The next day the patient's temperature was 100°F. and the following day it was 101°F. Inspection of the burn at this time revealed considerable purulent material below the knee. (Fig. 4.) Culture of this pus showed a slightly hemolytic staphylococcus and Bacillus proteus. The chlorophyll dressings were discontinued and Dakin's compresses were begun. Reverdin's grafts were applied to a small area of third degree burn on January 28th. The patient was discharged from the hospital on February 2nd, with about 80 per cent take of the grafts. He was treated in the out patient department for about three weeks before healing was complete. Although no control was possible, there was nothing to suggest that chlorophyll assisted in the healing process in this case. As a matter of fact, quicker healing would have been expected following Reverdin's grafts.

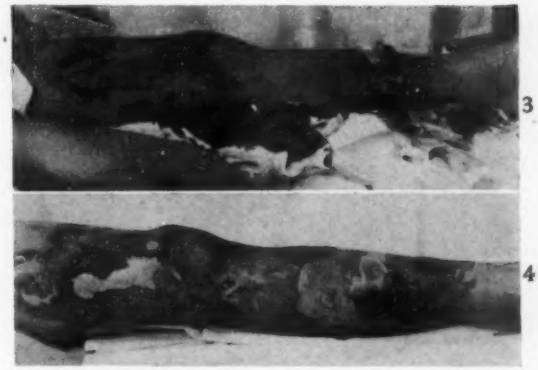


Fig. 3. Case viii. First dressing of leg one week after the application of chlorophyll ointment for moderately severe burn.

Fig. 4. Case viii. Second dressing on tenth day of burn, showing staining of tissues with chlorophyll and moderate infection of the deep second degree burns; the darker area of the leg was subsequently grafted.

A controlled experiment was possible on the following patient because all four extremities were burned:

Case ix. J. R., a colored male aged forty, was admitted January 7, 1944, with severe burns of both hands, arms, legs and thighs. The extremities on the right were treated with chlorophyll ointment and those on the left were treated with petrolatum gauze. Pressure dressings were applied over all the ointments. A large amount of plasma was given. The first dressing was on the tenth day. No important difference in healing and sloughing was discernible. (Fig. 5.) The same dressings were replaced and these were not disturbed for ten days. Inspection of the hands at this time showed almost identical lesions. The same ointments were applied again. A week later both hands were ready for grafting, the sloughs having separated leaving granulating areas which looked exactly the same. (Fig. 6.) No

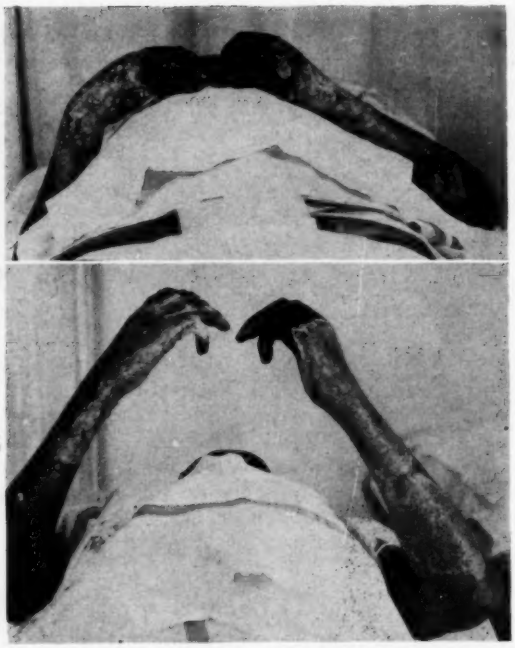


FIG. 5. Case IX. First change of dressings on tenth day after severe burn of hands; right hand had been treated with chlorophyll ointment, left hand with vaseline gauze; degree of healing and sloughing identical.

FIG. 6. Case IX. Twenty-sixth day of burn; no difference in healing of hand treated with chlorophyll (right) and that treated with vaseline gauze (left).

favorable effect from the chlorophyll was evident in this case.

CHLOROPHYLL IN THE TREATMENT OF ULCERS AND INFECTIONS

Reference has already been made to several articles reporting clinical experience with chlorophyll preparations.[5,6,11–14] All of these authors have made favorable reports although with the exception of Boehringer no controlled studies were carried out. The latter reported thirteen cases. Eight of these cases had controls in which half of a wound was treated with chlorophyll and the remaining half treated with the control ointment. Boehringer thought that the granulation tissue was more healthy under chlorophyll but the control areas received Thiersch grafts just as well as the treated areas and were healed in the same period of time. It was stated that five torpid wounds were stimulated by chlorophyll. No controls were available for these.

We have used chlorophyll preparations in the treatment of twenty-six patients with ulcers or other wounds with sluggish healing or indolent infection. Most of the patients had varicose or phlebitic ulcers of the ankle, but the list also included old third degree burns, an x-ray burn, infected donor sites, infected surgical wounds and one ulcer over an old area of osteomyelitis.

It is difficult to evaluate the role of chlorophyll ointment or, for that matter, any ointment in the treatment of varicose ulcers. In most cases the local medication has been used only as an adjunct to the more rational treatment of the underlying defect, namely, the circulatory deficiency. Unna's paste boots were used extensively and, when indicated, veins were ligated or injected. The clinical histories of these patients have been abstracted with particular reference to the fate of their ulcer or ulcers. Some of these histories covered a period of several years, and there was information about ulcers which appeared and healed under various treatments before and after the chlorophyll experimental period. The following case history is presented as an example:

CASE X. R. C., a white female aged forty-six, was first seen on July 22, 1941, with a varicose ulcer of the right ankle. She was advised to have several Unna's paste boots to be followed with ligation of the varicose veins. Four weeks later after four boots had reduced the signs of infection and inflammation she was advised to proceed with the vein ligation. However, since the ulcer had shown so much clinical improvement, this advice was refused. The ulcer was completely healed on September 12, 1941 (forty-two days).

Nine months later on June 30, 1942, she returned with a recurrence of the ulcer. Unna's paste boot was applied. On July 7th a vein was injected. After five more boots at weekly intervals the ulcer was healed again (fifty-three days). A year later on August 17, 1943, she returned with a recurrence of the ulcer. She was strongly urged to have the veins in both legs ligated. She refused this advice again. She was treated with boots at weekly intervals for a month, with little improvement in the ulcer. Then followed a period of no treatment; however, on January 17th she submitted to the operation of vein ligation. Then followed a series of injections of sclerosing solutions until March 28th when she was discharged from treatment with the ulcer healed. (Time of healing after ligation was two months.)

On September 28, 1944, she returned because

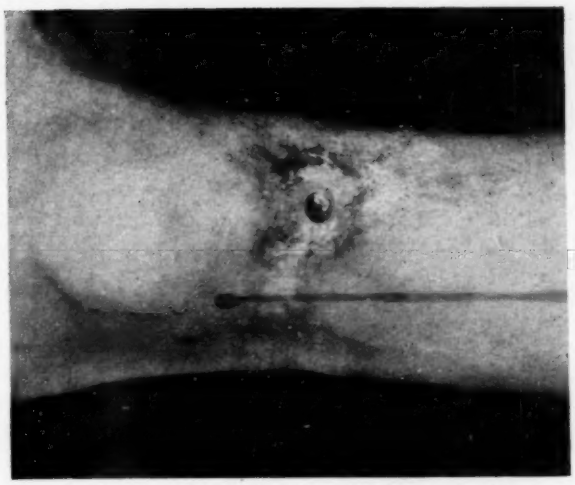


FIG. 7. Case XI. Ulcer in skin of ankle over old compound fracture with osteomyelitis; no change with three months of treatment with chlorophyll.

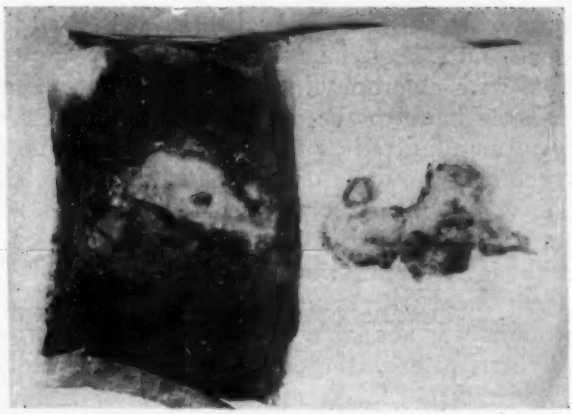


FIG. 9. Photograph of dressings removed from symmetrical wounds of both wrists. Right, chlorophyll-penicillin ointment; left, penicillin ointment. There is an equal amount of pus on each of the dressings.

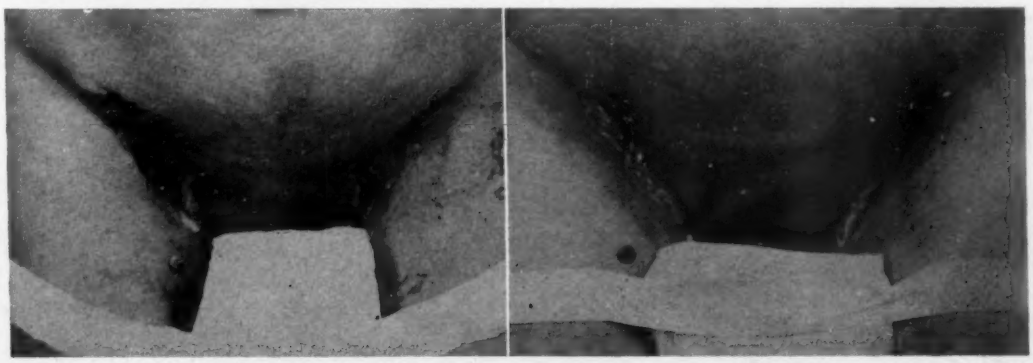
of the development of ulceration on the other leg. This ulcer was treated with chlorophyll ointment under Unna's paste boots from October 17th to November 21st (five applications of chlorophyll). Healing was complete on December 5th (time of healing, sixty-seven days). On August 4, 1945, there was another small ulcer which was treated with Unna's paste boots alone until October 1st when healing was complete (time of healing, fifty-six days).

It will be noted that this patient had five episodes of ulceration. With the exception of the period when treatment was discontinued because operation was being urged, the periods of healing were slightly shorter when ordinary paste boots were used without the chlorophyll ointment.

A study of the histories of the other eighteen patients with varicose and phlebitic ulceration leads us to believe that in no instance was a favorable effect produced by the use of chlorophyll.

The following case report is presented because it shows the failure of chlorophyll ointment to stimulate healing in an indolent wound overlying an area of old osteomyelitis:

CASE XI. P. B., a white male, sustained a compound fracture of the right tibia and fibula in 1930, at the age of twenty-eight. Osteomyelitis developed and there was some sequestration. Bony union finally occurred in 1932. On January 10, 1945, he complained of a small ulcer which had formed over the scar of the tibia. This had followed a blow. Scarlet red ointment was applied at weekly intervals for a month, after which the patient was referred to us for chlorophyll therapy. On February 13th examination showed a wound measuring 5/16 inch in diameter. (Fig. 7.) Chlorophyll was applied at weekly intervals from that date until May 5, 1945 (three months). On that day the observer stated, "The lesion looks worse



8A 8B

FIG. 8. Case XII. Symmetrical, infected, broken-down surgical wounds of the inguinal region. (A) before experimental treatments; (B) after treatments, one week. Wound on patient's left treated with chlorophyll solution; that on right treated with Dakin's solution. The latter is better healed.

today. It is not nearly healed. It goes down to bone and it is obvious that it is never going to heal with chlorophyll therapy. The patient is referred back to the orthopedic department." He was admitted to the hospital and sequestrectomy was done on June 18th. In spite of this operation and forty-four subsequent dressings in the outpatient department the patient still has a draining wound on his ankle.

A patient with symmetrical infected surgical wounds was available for the testing of chlorophyll irrigations, using one wound for the control.

CASE XII. J. P., aged thirty-two, had a radical dissection of the glands in both inguinal regions because of malignancy. Both wounds "broke down" and became infected. It was decided to irrigate one of these periodically (three times per day) with chlorophyll solution while the contralateral wound was similarly treated with Dakin's solution. At the beginning of treatment the situation was that seen in Figure 8A. After a week the wound treated with Dakin's solution looked somewhat better although both sides were grafted on the same day. (Fig. 8B.)

Smith and Livingston reported that experimental infected lesions healed very promptly when treated with an ointment containing both chlorophyll and penicillin.[10] We added penicillin to the 1 per cent chlorophyll ointment in the amount of 250 units per gram of ointment. The same amount of penicillin was incorporated in the plain ointment base. These two ointments were applied on several symmetrical areas of two patients with burns which had exhibited poor healing with infection. No benefit from the use of either ointment was discernible. Two identical burns of the two wrists of a patient were dressed with the ointments. Six days later the dressings were removed and photographed. (Fig. 9.) An identical amount of purulent material was removed with the dressings from both wounds.

SUMMARY AND CONCLUSIONS

We have made some observations on the effect of chlorophyll preparations on the healing of clean and infected wounds. In animal experiments (cutaneous wounds in guinea pigs) there appeared to be a slight advantage for chlorophyll, but this impression was not substantiated in the dermatome donor sites on humans. The use of chlorophyll in the treatment of burns and in a variety of surgical infections including varicose ulcers failed to show any benefit from the material.

It is our opinion that in the studies described it was not demonstrated that chlorophyll has a therapeutic effect in wound healing.

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THYROIDECTOMY USING LOCAL ANESTHESIA*

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MORTALITY in thyroid surgery may occur as the result of many factors. However, anesthesia plays an important role. The best surgeons occasionally have a death on the operating table which can be attributed to the general anesthetic alone. In a similar manner, there are patients who return to bed but fail to regain consciousness. In spite of the use of propylthiouracil and other drugs in the preparation of the patient we are still going to operate in severe cases.

The author has had a series of over 1,000 thyroidectomies performed under a local anesthetic, and not one death could be called an "anesthetic death." It seems very strange, therefore, that more importance is not placed on the use of local anesthesia. Lahey[1] has expressed the case in the following words: "When a patient with serious hyperthyroidism is operated upon, the margin of safety is undoubtedly at times quite narrow. It must be expected also at times in this operation, even the most experienced thyroid surgeons will meet with technical operative difficulties. Likewise, it must be admitted that even the most experienced anaesthetists will also meet with anaesthetic difficulties during thyroid surgery. When these two difficulties, an interference with breathing, producing anoxemia, and technical difficulties, are combined during a thyroid operation, they can result in an operative fatality."

Clinically, thyroid patients suffer from cardiac derangement in varying degree. They also have liver damage ranging from mild dysfunction to liver degeneration. These livers are extremely sensitive to toxic products. Although the anesthetic agents ordinarily used are relatively non-toxic to the normal liver, there may be a reaction in these abnormal and sensitized livers. Certainly we know that they react badly to even small degrees of anoxemia. No general anesthesia is possible without some degree of anoxemia while in local anesthesia this can readily be avoided. In order to emphasize the sensitivity of the liver in thyrotoxic cases a review of the literature has been made which proves to be very illuminating. It is believed that extracts of these writings will serve to drive home the thought that the liver should not be subjected to the effects of general anesthesia.

Liver Changes. Monroe A. McIver[2] states, "In view of the intense and varied metabolic activity of the liver, it would seem reasonable to assume that this organ especially would feel the increased drive of hyperthyroidism, and in the recent literature, increasing emphasis has been placed on the critical importance of the liver changes occurring during this procedure. Evidence of these changes may be manifested by jaundice,[3,4,5] which not infrequently occurs in association with the more severe forms of thyrotoxicosis; by other disturbances of liver function measurable by various laboratory tests;[4,6,7,8] and by liver lesions often found at autopsy in those dying of the disease.[3,5,9,11] Whether the injury is due to the effects of an increased amount of thyroid hormone on the liver cells or to the injurious action of some other substance or factor in a liver made vulnerable by the functional strain of hyperthyroidism, is a moot point.[11] In any case, damage to the liver must be taken into consideration in the clinical management of a case of hyperthyroidism, particularly when the added stress of anaesthetic and surgery is necessary."

Beaver and Pemberton[3] in their analysis of 107 autopsies on patients who died of exophthalmic goiter noted two outstanding types of hepatic change, acute and chronic. The acute changes they described as fatty metamorphosis and central or focal necrosis. Although these changes may occur in a variety of conditions, it is noteworthy that 91 per cent of these autopsies show the characteristic changes. These liver changes may arise in acute cases, as in a case reported by Raab and Terplan[12] and Kerr and Rusk[13] in which they reported the clinical and pathologic findings in a patient operated upon for hyperthyroidism from which he had suffered for about three months. He ran a rather stormy

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postoperative course during which time jaundice developed which gradually became deeper, and death occurred fifteen days after operation. Autopsy showed the liver with almost complete loss of architecture and with necrosis and cellular infiltration.

Various liver function tests have been developed; and although this is not the place for detail, it may be shown that these also prove an impaired liver function during hyperthyroidism. Youmans and Warfield[8] carried out their test in twelve cases and found increased bilirubin in seven. A Quick hippuric acid test has been carried out widely, and Bartels[6] found that reduction in liver function was shown by this test to exist in a high proportion of thyroid cases. Only eighteen of 148 such patients gave a normal response at the time of admission to the hospital. The degree of impairment of liver function appeared to be in direct proportion to the severity of the hyperthyroidism. The theory has been advanced that the changes taking place in the liver are themselves responsible for the occurrence of the thyroid crisis;[14] a similarity has been seen between certain clinical features of the crisis, especially hyperpyrexia, and the syndrome that accompanies so-called "liver deaths."[1,14]

Effect of Anoxemia on the Liver in Hyperthyroid Cases. Recent experimental work[15] shows that when hyperthyroid animals were exposed to artificial atmospheres containing low percentages of oxygen, degenerative lesions could be demonstrated in the liver, varying from slight changes when the anoxia was of short duration to extensive degeneration when the anoxia was of longer duration. The livers of normal animals similarly exposed to anoxia showed no liver lesions. The mortality among the hyperthyroid animals was high; there were no deaths among the controls. Also, since the liver lesions associated with hyperthyroidism have been reported only in severe or long-standing cases, it is obvious that thorough recognition and instant treatment of the underlying disease would largely do away with this complication. In the more acute fulminating type of thyrotoxicosis it has been suggested that a diet high in protein and carbohydrates could possibly protect the liver against damage. This, however, would not be expected to protect the hyperthyroid liver as it does in a normal liver. Vitamins are also advised during the preparatory stage for surgery.

Since the liver under conditions of hyperthyroidism shows increased susceptibility to injury and it is uncertain how much protection is afforded by measures that would be effective under ordinary conditions, special precautions must be taken to guard this organ from exposure to deleterious factors. Other deleterious factors assume particular importance when an operation is to be performed. An anesthetic should be selected which has a minimum toxic action on the liver, and the greatest care should be used to see that no anoxemia results during or subsequent to administration of this anesthetic. In the more fulminating cases of hyperthyroidism the use of local rather than general anesthetic should receive careful consideration. During the postoperative care if any evidence of anoxemia develops due to respiratory obstruction or pulmonary complication, prompt oxygen therapy should be introduced

Cardiac Condition. That cardiac deficiency exists is a clinical fact. The cause, however, is still a matter of uncertainty and debate. John J. Pemberton and Joseph Miller[16] writing on the subject state, "A long line of famous investigators has served to emphasize the important direct relationship between alterations in cardiac function and efficiency, and exophthalmic goiter. To be added to this group are those patients with hyper-functioning adenomatous goiters and independent heart disease, while still a third category should include cases of cardiac malfunction and adenomatous goiters without hyperthyroidism." Many papers on the underlying causes of the circulatory derangement have been published, but the etiologic factors are still but ill understood. It is usually stated of patients with hyperthyroidism that the clinical signs related to the cardiovascular system are easily explicable on the basis of an increased circulatory rate. The latter is merely the resultant of necessary changes in the body economy dictated by an increased metabolic rate. Fatty and parenchymatous degeneration, perivascular round cell infiltration, fibrosis and the formation of granulation tissue are considered to be specific changes by Fahr and Kuhle[17] and by Goodpasture.[18]

Similar changes have been found by Menne et al.[19] in the hearts of rabbits in which hyperthyroidism was experimentally produced. These authors suggested that similar changes might be produced by cardiac overwork, irrespective of the presence of an excess of thyroxine in the

circulation. However, Weller[20] and others were unable to demonstrate convincing morphologic changes in material obtained at necropsy. They reported that a careful study of the hearts of thirty-five patients with exophthalmic goiter showed with but few exceptions no gross or microscopic pathologic changes not equally represented in a carefully matched series of controls. In addition, the hearts of fifty-five patients with adenomatous goiter failed to show any significant difference in the incidence of pathologic lesions as compared to that of the controls.

Rake and McEachern[21] made a potent suggestion. They believed that perhaps too much emphasis has been placed on the study of structural change in the myocardium, with consequent neglect of important alterations in the metabolism and function of the muscle fibers. The results in experimentally produced hyperthyroidism obtained by Hoet and Marks,[22] and Defauw and Andrus[23] should merit careful examination. These investigators were unable to find glycogen either microscopically or by chemical analysis of the myocardium. Therefore, a close analogy to the liver may well be present in which, with depletion of the reserve of glycogen, significant changes in hepatic function may be observed. With depletion of glycogen of the myocardium as a result of the increased volume output, morbid anatomic changes may well be found. Again, this hypothesis is tenable if the patient with hyperthyroidism is considered in terms of altered metabolism.

ANESTHESIA

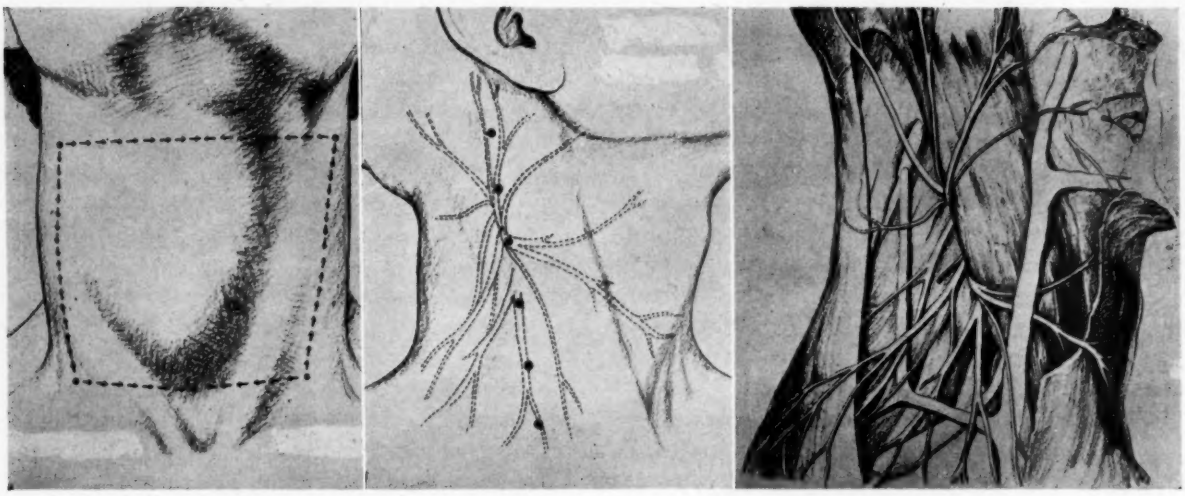
General Anesthetics. It is generally admitted that there is some degree of toxicity to the liver with every type of general anesthetic. It might be argued that this in itself is small in degree. However, there is also always an element of anoxemia in varying degree. When in addition to this there is any unpredictable technical difficulty with the surgery or anesthetic, it immediately becomes of major proportion and may be of great importance.

Ether produces a relatively severe anoxemia. It also produces large amounts of mucus in the trachea and bronchial tubes. Postoperative vomiting may be severe, causing alterations in the electrolytes, and may be a factor in production of crises. Nitrous oxide in itself is relatively non-toxic but is a weak gas requiring a high concentration. Anoxemia may therefore be severe. Cyclopropane is stronger and the patient can be carried on a higher percentage of oxygen. Increased experience, however, has shown that it has a tendency to throw the heart into ventricular fibrillation causing sudden death. Pentothal® is contraindicated in the presence of liver damage. It also produces anoxemia.

It may be seen, therefore, that none of the aforementioned agents are entirely satisfactory.

Local Anesthetics. Certain objections to local anesthesia noted in the literature are discussed briefly at this point.

One objection is that local anesthesia produces anoxemia. Speaking generally, no anoxemia is produced by a local anesthetic. Occasionally oxygen is given during the operation so that anoxemia can readily be avoided. That the administration of local anesthesia delays the surgeon ten minutes is admitted, but a general anesthetic takes longer to administer. It would seem that the surgeon would prefer to take the "bother" to administer a local anesthetic if by doing so he could save a higher percentage of patients. The objection that an injection of novocain is a mental strain on the patient is not an effective argument. The author has experienced no such difficulty. Any such objections have been trivial and are far outweighed by the advantages of this method. In fact, many patients are encouraged rather than discouraged by the thought that local instead of general anesthesia is to be used. The objection that local anesthesia is insufficient and that there is nearly always a need for supplemental anesthesia is not true. It means for the most part that these surgeons have not learned the proper technic or that it is carelessly employed. The proper method of administration of local anesthesia is easy to give and easy to learn. The argument that preoperative medication must be so heavy as to amount to anesthesia is incorrect. The author uses normal amounts of morphine; ¼ gr. is routine and may be less in older people. In younger persons occasionally an H.M.C. No. 1 is used. The author also gives 3 gr. nembutal two hours before surgery. After the initial injections have been made the patients usually sleep during the operation but may easily be aroused to talk in case that is desired. It may be seen that they are definitely not in a "narcotic state." Another objection that has been made to the use of local anesthesia



1 2 3

FIG. 1. A complete ring of superficial infiltration is made using 1 per cent novocain.
FIG. 2. Deep injections penetrating superficial fascia and deep fascia are made every half inch along the posterior border of the sternomastoid muscle.
FIG. 3. The illustration shows the cervical plexus which is blocked by the infiltration described in Figures 1 and 2.

is that it "does not allow delicacy of handling of the thyroid and that proper exposure cannot readily be obtained." This is quite remote from the truth. It definitely does not allow rough handling, and exposure is quite as good as under general anesthesia. Three drops of adrenalin to 1 ounce of novocain solution is used. As no more than 3 ounces of this solution are given, the patient does not receive an excessive dose of adrenalin. The blood pressure has never been raised in any severe degree and no other effects thought to be due to an adrenalin reaction have been noted. A novocain reaction has never been seen in the author's series of cases. I believe this is due to the procedure of drawing back on the piston of the syringe before the injection is made thus making sure the needle is not in a vein.

The advantages of local anesthesia may be enumerated as follows: (1) It is non-toxic to the liver. (2) It does not produce anoxemia. (3) It gives adequate exposure. (4) It does not force the patient to undergo the effects of general anesthesia. (5) It does not irritate the trachea, and it minimizes tracheitis, bronchitis and other respiratory complications. The numerous articles in the literature describing methods of sucking out excessive mucus from the bronchi only emphasize the disadvantages of general anesthesia.

TECHNIC OF LOCAL ANESTHESIA

The technic as used by us is very simple and easy to learn. It must, however, be given with great care to be sure not only that the needle is not in a vein but also to place the novocain where it will be most effective.

A wheal is raised in the suprasternal notch and one over the lower part of the thyroid cartilage. From these novocain is superficially injected in a circle surrounding the entire operative field. This circle extends far enough laterally so that the needle used for deeper injection will not have to pass through areas of skin which have not been anesthetized. (Fig. 1.)

A row of deep injections are now inserted along the posterior border of the sternomastoid muscle ½ inch apart. (Figs. 2 and 3.) These extend high enough to involve the posterior auricular nerve. The needle passes through the skin, superficial fascia, and penetrates the deep fascia. If the deep fascia is not penetrated, the novocain will be in the fatty layer and anesthesia will not be complete. For each of these deeper injections 2 cc. 1 per cent solution is the quantity used.

SUMMARY

1. The author reports a series of 1,000 thyroidectomies performed under local anesthesia with a mortality of .9 per cent for the first 500 cases and .5 per cent for the last 500.

2. The liver in cases of thyrotoxicosis suffers impairment varying in degree from mild dysfunction to actual necrosis.

3. These livers are particularly susceptible

to injury whether it is from the toxic effects of the anesthetic agent or from anoxemia.

4. The heart muscle has also been damaged. It is more susceptible to certain anesthetic reagents and may even go into systolic fibrillation when cyclopropane is used.

5. A review of the literature is made to emphasize the damage to the heart and liver.

6. Objections to the use of local anesthesia are discussed.

7. The advantages of local anesthesia are pointed out.

8. The author believes that the newer drugs do not make operations safe in all cases. We still are meeting serious cases.

9. There is a definite mortality from general anesthesia which could be avoided by the use of local anesthesia.

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A SAFE METHOD OF INDUCING LOCAL DIGITAL ANESTHESIA

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GANGRENE of a finger or toe as a result of the use of a local anesthetic injected at the base or along the shaft of a digit is an ever present possibility.[11,12] This disastrous complication can be avoided. The technic presented herein of administering the local anesthetic agent obviates this danger, I believe, as I have used it on over 200 patients without circulatory embarrassment ever occurring in any digit.

FIG. 1.

Technic. Some 5 cc. or more of 2 per cent procaine hydrochloride are injected into the interosseous spaces on each side of the metacarpal or metatarsal bone of the digit which is to be anesthetized. (Fig. 1.) Epinephrine is not mixed with the procaine. A small hypodermic needle is used first in making a wheal on the dorsal aspect of the hand or foot. Through this a longer needle is inserted down close beside the bone almost to the palmar or plantar skin. The fluid is injected slowly.

There is an abundant collateral blood supply distal to the zone in which the injection is made. The dorsal metacarpal arteries, the palmar metacarpal arteries from the deep palmar arch and the palmar digital arteries from the superficial palmar arch all intercommunicate with side-connecting branches in the web and at the base of each digit.

The collateral circulation of the foot at this zone is equally as good.

At no time have I ever noticed blueness, pallor or diminished blood flow to the anesthetized digit either during or after anesthesia.

The degree of anesthesia is as complete as when the solution is injected into the digit itself although one must wait about five minutes for it to take full effect.

Most authors [3,5,8,11–14] agree that epinephrine should not be mixed with procaine hydrochloride although gangrene has been reported as having occurred in patients on whom it was not used.[7,12]

Kaufman,[7] McLaughlin[11] and O'Neil[12] insist that the anesthetized digit should not be soaked in warm water until the anesthetic effect has completely disappeared.

I have been unable to find any one instance in which gangrene of a digit occurred as a result of the intermetatarsal injection of a local anesthetic agent. Heinicke reports a case in which prolonged ischemia of the second toe occurred as a result of the injection of procaine and epinephrine in the first intermetatarsal space, but the two recovered. Heinicke's patient gave a history of having had repeated spasmodic attacks of numbness and blanching of the fingers from exposure to cold. This suggests that in any person with such a history more than the usual care should be exercised in inducing such an anesthesia and, most certainly and most emphatically, epinephrine should not be used.

Several authors, whose textbooks on anesthesia I have consulted, have mentioned the intermetacarpal and intermetatarsal route of procaine injection. However, none have recommended that it be used exclusively in digital anesthetization and none have mentioned its importance in preventing gangrene.

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ACUTE RETROCECAL APPENDICITIS*

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ACUTE retrocecal appendicitis is frequently associated with atypical signs and symptoms in cases of appendicitis. As a result the diagnosis may be delayed and morbidity and mortality rates increased. Collins[1] reported 751 instances of acute retrocecal appendicitis among 3,003 consecutive appendectomies performed for acute appendicitis. He emphasized the frequent bizarre nature of the early signs and symptoms and stated that approximately 25 per cent of all cases of appendicitis are of a retrocecal nature. The majority of his patients had been treated previously by physicians for similar attacks of abdominal pain. In 56.9 per cent these attacks had been diagnosed as diseases of the gallbladder, pyloric region, pelvis or the right part of the genitourinary tract. Among 280 women of this series gynecologic operations were performed while among the 471 men operations of the upper part of the abdomen were performed.

In Collins' series only 142 (18.9 per cent) presented the fairly classic signs and symptoms of acute appendicitis described in the textbooks. The sign most frequently obtained was production of intense pain by exerting steady, deep pressure on the right flank lateral to the right psoas muscle. Rectal examination was not significant in the majority, but in approximately 30 per cent it gave the only positive sign of existent acute appendicitis. The urine of 104 patients contained red blood cells, and in 152 pus cells were present. The correct preoperative diagnosis of acute retrocecal appendicitis was made in only 304 (40 per cent), and fifty-eight deaths (7.72 per cent) occurred.

Analysis of Personal Cases. For some time we have been impressed with the significant delay in making the diagnosis of appendicitis when the appendix is in a retrocecal position. Often the symptoms were completely masked until complications had arisen. For this reason we thought it important enough to reiterate and to review the problem. In order to do this an analysis was made of fifty-two patients with acute retrocecal appendicitis consecutively operated upon by one of us (L. K. S.). Relatively few of these patients showed the textbook or classical picture of appendicitis. Those that did manifest such a picture were usually treated within the first twenty-four hours of the disease and for the most part were treated during their first attack. On the other hand, the balance of the patients for the most part had had multiple attacks which had been diagnosed by their physicians as varying from cholecystic to pelvic disease. Some patients had had as many as twelve attacks and had been treated over as long a period as two to three years. The only consistent finding was deep localized tenderness. This was frequently in the right flank but often elicited in the region of McBurney's point. Often the complaints were mild and the patients would state that they had not felt well, they had no appetite, were slightly nauseated, and had a dull, aching pain in the right abdomen or lumbar region. Rectal examination was significant in nearly one-half of the patients.

CASE REPORTS

The following case illustrates the delay in diagnosis because of the paucity of symptoms:

CASE I. A female aged thirty-two years consulted her physician one week before admission because of a vague right-sided abdominal pain. This had come on during a normal menstrual period. There was no nausea or vomiting but the patient had a fever of 100°F. Her physician examined the abdomen daily but no significant findings were noted. The temperature increased to 102°F. and on admission there was deep tenderness in the lower right quadrant of the abdomen, a leukocyte count of 16,000 and exquisite tenderness in the cecal region on rectal and pelvic examination. At operation a gangrenous retrocecal appendix was found.

The presence of diarrhea has delayed the diagnosis in some instances.

CASE II. A boy, aged four years, was treated by his physician for five days for diarrhea asso-

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ciated with generalized abdominal pain and some lower right quadrant tenderness. There was no nausea, vomiting or fever. The patient was hospitalized on the fifth day. At this time a fever of 101°F. and a leukocyte count of 21,000 were noted. At operation a ruptured retrocecal appendix with a fecalith obstructing its proximal portion was found.

The importance of obstruction as a cause of appendicitis has been previously stressed by one of us (L. K. S.).[2] The majority of our cases showed evidence of obstruction. This was usually due to fecaliths but in some instances adhesions or strictures with kinking secondary to previous appendicitis were present. It is this obstruction which causes many of the characteristic signs and symptoms of the acute retrocecal appendix. The most characteristic symptom was a colicky type of pain of sudden onset and intermittent in character. Vomiting was not characteristic and the abdominal findings were minimal. The patient may go on with apparently insignificant symptoms for several days before obstruction becomes complete. When this occurs vascular damage to the wall is rapid and rupture is inevitable. The unobstructed type of acute appendicitis located in the retrocecal position was more prone to produce the typical picture of appendicitis than the obstructive type.

At times there is some confusion in the differentiation of appendicitis and carcinoma of the cecum. Actually the finding of cecal malignancy in conjunction with acute appendicitis is unusual, but it is not unusual to find the patient with carcinoma of the cecum who has had his appendix removed in the past six months. It is frequently impossible in treating appendicitis with associated typhlitis or acute inflammation of the cecum to differentiate between this acutely inflamed cecum and appendix, and a neoplasm. This occurred in two of our cases; the following case is illustrative:

Case III. A man fifty-four years of age was referred fifteen days after the onset of his illness with the diagnosis of carcinoma of the cecum. He had had intermittent cramp-like abdominal pain of two to three weeks' duration. This had localized in the lower right quadrant of the abdomen and was associated with marked tenderness, slight fever, leukocytosis and a palpable mass. A barium enema had been interpreted by the roentgenologist as being suspicious of cecal malignancy. At operation the mass was at first thought to be malignant, but multiple biopsies were reported as inflammatory. A ruptured retrocecal appendix was removed and subsequent examinations have confirmed the operative diagnosis.

Approximately 20 per cent of the patients who have acute retrocecal appendicitis will show definite urinary tract signs and symptoms. These are usually associated with red blood cells or pus cells in the urine.

Case IV. A boy, aged ten years, had had a gross hematuria for four days. There had been chills, fever, nausea and vomiting. The abdominal findings were minimal but rectal examination was significant. At operation an acute ruptured retrocecal appendix was found. This was lying across the course of the right ureter and had produced considerable periureteritis. The urinary signs and symptoms disappeared following surgery.

Other patients have presented a clinical picture not unlike acute nephritis.

Case V. A man forty years of age was hospitalized elsewhere because of chills, fever, nausea, vomiting and vague symptoms referable to the right side of the abdomen and right kidney. He was treated for a period of three weeks for an acute urinary tract infection and was then dismissed. About three weeks later he developed a similar attack. In spite of the urinary tract findings we performed an operation and an acute ruptured retrocecal appendix was removed. Following this surgery the urinary findings completely disappeared and the patient has remained well.

Strange as it may seem, the condition with which intermittent hydronephrosis is frequently confused is appendicitis. About one-fourth of the patients in various series of hydronephrosis have had appendectomies previously. Many others have been told that their symptoms were due to appendicitis and were advised to have the appendix removed. In one of our cases the hydronephrosis was recognized at time of appendectomy.

Case VI. A girl, aged seven years, was admitted with right-sided abdominal pain of six hours' duration. The pain was referred to the back but was not associated with urinary symptoms. There was nausea and vomiting, deep localized tenderness over McBurney's point and some abdominal distention. The patient's temperature was 99°F. The leukocyte count was 19,500, with 85 per cent neutrophiles. She had

been treated by physicians in a hospital elsewhere for two similar attacks and on one occasion had been seen by a urologist. He had excluded the urinary tract because of the consistent absence of urinary findings. We could not exclude acute retrocecal appendicitis and an exploratory operation was performed. The appendix was retrocecal and did show some evidence of disease but it was not sufficient to account for the marked leukocytosis and symptoms. The incision was enlarged and a large complete hydronephrosis of the right kidney found. Appendectomy and subsequently nephrectomy were performed with relief of symptoms.

A number of patients have been referred to us with the diagnosis of appendicitis and have been proven to have ureteral calculi. In a few cases the diagnosis of appendicitis was needlessly delayed by the physician's attempt to exclude diseases of the urinary tract. On the other hand, often diseases of the urinary tract are misdiagnosed for appendicitis. The number of cases in which the appendix has been removed in which ureteral or kidney stones are later found continues to be larger than it should be.

A greater incidence of rupture and gangrenous changes occurs in retrocecal appendicitis than in other forms. In our series more than 15 per cent were found to be ruptured and nearly 40 per cent were gangrenous at operation. There was no mortality in our series but the morbidity rate was increased. The appendix was removed at the first operation in all cases but one. This is in accordance with our policy of generally removing the appendix regardless of the presence of rupture in any case of appendicitis. Sulfa drugs and antibiotics were used with advantage in many of the cases.

COMMENT

The acute retrocecal appendix presents a clinical picture which should be considered as a specific entity. It is anatomically placed so that the abdominal findings may be minimal. There has been considerable delay in recognizing the condition and as a result complications such as perforations have developed in many. The removal of an acute retrocecal appendix is technically more difficult than in other types of appendicitis. A number of authors have stressed that the operative manipulation is one of the factors in spreading the infection. We have avoided much of this manipulation by frequently performing the so-called Robin type (removal from the base outward) of appendectomy. The right pararectus incision has been used almost routinely. Inflammation of the cecum frequently occurs, which is difficult to differentiate from early carcinoma. In many cases obstruction of the appendix with resulting appendicitis is one of the first symptoms of cancer of the cecum. In any suspicious case biopsies and subsequent follow-up studies with roentgenologic examination of the colon are made.

It is important when operating for appendicitis to correlate the clinical picture with pathologic findings. When these cannot be correlated, the incision should be sufficiently enlarged so that careful, complete examination of the abdomen can be carried out. The importance of this was demonstrated in Case VI.

It must be recognized that many cases of acute retrocecal appendicitis are associated with abnormal urinary findings. On the other hand, diseases of the urinary tract must not be confused with appendicitis. A careful history with inquiry into urinary symptoms and examination of the urine are essential. In some instances a cystoscopic examination and roentgenologic studies may be necessary. However, it is our belief that these latter studies should not be allowed to delay the diagnosis and treatment of appendicitis.

Perhaps one of the greatest adjuncts that may assist in reducing the mortality and morbidity rate is the judicious use of the sulfa drug and antibiotics. After a careful review of the bacteriologic studies of peritonitis in these cases it is evident that the sulfa drug may not be entirely efficient. A combination of penicillin and streptomycin in large doses may be more effective because of the combined range of antibacterial activity.

SUMMARY

An analysis has been made of the problem of acute retrocecal appendicitis, with discussion of the diagnostic problems presented. A review of certain illustrative cases was selected from a group of fifty-two consecutively treated patients.

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APPENDICITIS IN A RURAL HOSPITAL

A TEN-YEAR STATISTICAL SURVEY

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THIS is a statistical survey of appendicitis in a rural hospital for the ten-year period from January 1, 1938, to January 1, 1948. Berwick Hospital has accommodations for sixty-two beds and thirteen bassinets. There is no house physician. Its staff is well organized and the services are divided among its members. The nursing care is adequate and supervisors often act in lieu of interns in giving intravenous medications, starting Wangensteen suctions and occasionally act as first assistants in emergency operations and administer ether in deliveries. Major surgery is done most frequently by two surgeons of the regular staff and occasionally by visiting surgeons of the auxiliary staff. The equipment for major surgery has been inadequate and insufficient. There is no house anesthetist, the anesthesia being given mostly by one general practitioner and infrequently by the patient's physician.

There were 1,574 major operations performed during the past ten years, 722 or 45.8 per cent of which were appendectomies. The appendectomies were classified as acute, perforated and chronic. Since the pathologic reports were very few due to the absence of a house pathologist, the diagnosis was taken from the surgeons' remarks on the operative sheets. Of the 722 appendectomies, 506 or 70.1 per cent were acute, forty-six or 6.4 per cent were perforated and 216 or 29.9 per cent were chronic. (Figs. 1 and 2.) The war years, with a drain on physicians, reduced the total number of appendectomies but increased the percentage of perforated cases to 11.5 per cent. Appendectomies performed on rural district patients amounted to 252 cases or 34.9 per cent, which is about the same percentage of all admissions that are rural cases.

Even though in some cases the patients' charts were somewhat incomplete, an effort was made to evaluate the effect of the pathologic condition of the delay in operating, the taking of purgatives, the mode of transportation, pregnancy and sex since these are frequent factors aggravating the pathologic condition of the appendix.

The time of operation could not be determined in all cases. In those available for such analysis it was found that in the cases of perforated appendix in which patients had a good history the time was over twenty-four hours from the onset in the city patients and over thirty-six hours for the rural patients.

The majority of charts failed to mention whether or not a laxative was taken, but in 80 per cent of the perforated cases history of a laxative was obtained. The type of laxative comprised everything on the market from Epsom Salt and Sal Hepatica to Crazy Water Crystals.

Transportation had no appreciable ill effect on the condition of appendicitis. Traveling distance in town is very short. The rural roads are in good condition and the radius of service of this hospital is about 20 miles.

There were three cases of pregnancy with appendicitis. There was no evidence that pregnancy influenced the pathologic condition of the appendix.

There were 247 male and 475 female patients, a ratio of 1:1.92. This marked difference in sex might be due to the great percentage of chronic appendicitis found in females when an adnexal pathologic condition was present. The ages of the patients ranged from three years to seventy-eight years.

The average hospital stay for the ten-year period is 10.2 days. During the war years this average had gone up to as high as 13.5 days but had come down to an average of eight for the last two years. (Fig. 3.)

The type of incision and drainage used depended entirely on the surgeon's preference and did not influence in any way the outcome of the case. The writer, who performed about 40 per cent of the appendectomies, did not use drainage in any case except one. However, the other surgeons used drainage in practically all the perforated and gangrenous cases. The

average hospital stay for those patients who had no drainage is less than those with drainage. Regarding anesthetics, general anesthesia was given by choice, about 92 per cent. Spinal anesthesia was given by the writer to his own patients forty-eight times. Sodium pentothal® with general anesthesia was used in only a few cases in the past two years.

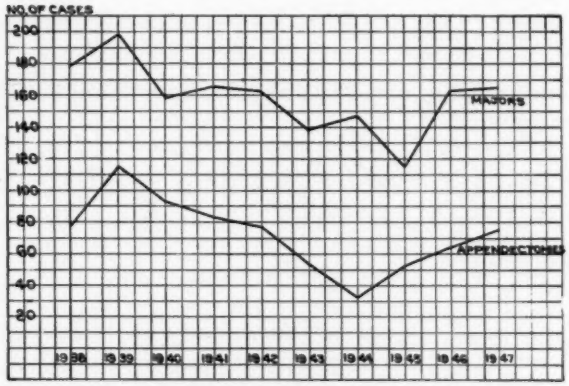

FIG. 1. Relative number of appendectomies as compared to all major surgery per year.

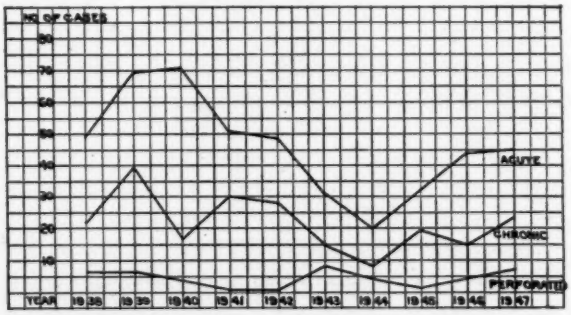

FIG. 2. Number and type of appendectomies per year.

The sulfonamides were used in many cases before penicillin was made available. The extensive use of antibiotics in the past two years has markedly decreased the hospitalization period and has undoubtedly influenced the mortality. During the past ten years there were five deaths in 722 cases of appendicitis, giving a 0.69 per cent mortality rate. Three of these deaths were among the perforated cases, giving a 6.5 per cent mortality rate for such cases alone. There were no deaths in the years from 1943 to 1947, inclusive. (Table 1.)

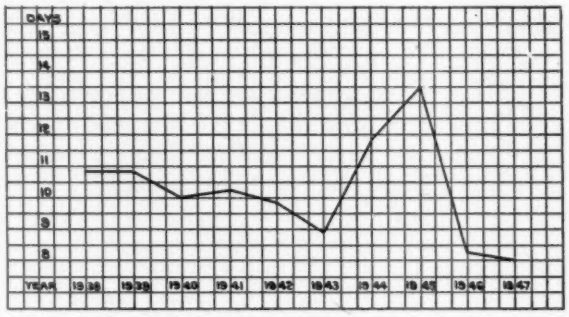

FIG. 3. Average number of days of hospitalization.

COMMENTS

Total admissions in the Berwick Hospital increased 221 per cent in ten years, but the total number of major operations and appendectomies did not change appreciably. Poor physical facilities and absence of a house physician, anesthesiologist and pathologist did not influence the morbidity and mortality rate in appendectomies in the rural hospital of Berwick, as compared with first class hospitals throughout the country. If present deficiencies are eliminated, the morbidity and mortality should be reduced to an ideal level in the future.

SUMMARY

1. A ten-year statistical study of appendicitis in a rural hospital is presented.

2. Seven hundred twenty-two appendec-

TABLE 1

DEATHS AT THE BERWICK HOSPITAL DUE TO ACUTE APPENDICITIS (1938–1948)

Year	Sex	Age	Acute (No. of Cases)	Perforated (No. of Cases)	Drainage	Laxative*	Rural	Anesthesia	Complication
1939	F	14	0	1	Yes	Yes	Yes	Local and general	Pneumonia
1940	M	12	0	1	Yes	Not noted	Yes	Ether	Peritonitis with obstruction
	M	29	0	1	Yes	Yes	No	Spinal	Anuria
1941	F	48	1	0	No	Not noted	Yes	General	Uremia and epilepsy
1942	M	63	1	0	No	Not noted	No	Ether	Virus pneumonia

*No deaths in 1938 and from 1943 to 1947.

tomies were performed of 1,574 major operations, or 45.8 per cent.

3. Appendectomies from the rural districts amounted to 34.9 per cent which is also the percentage of the total admission from the rural districts.

4. There were five deaths in 722 cases of appendicitis, giving a 0.69 per cent mortality rate.

5. There were forty-six cases of perforated appendix or 6.4 per cent of the total number, with three deaths or 6.5 per cent mortality rate. Of these three, two were patients from the rural district.

6. The average number of hospital days per case was 10.2. Transportation, pregnancy, sex and age had no marked effect on this mortality and morbidity. The time of operation and purgatives aggravated the condition, increasing the morbidity and mortality rate, while antibiotics decreased the hospitalization period and undoubtedly influenced the mortality.

PERSISTENT cases of sciatica are often due to a protruding disc and operation may afford prompt relief. Occasionally such a patient is operated upon and no slipped disc is found. If the surgeon will search further in such cases, he may occasionally encounter a cyst of the sacral or coccygeal nerve roots that is the etiologic factor and to remove which becomes necessary to effect a cure. These cysts arise from the perineurium on the extradural portions of the sacral or coccygeal nerve roots but are not usually demonstrable by myelography since these cystic cavities do not form any connection with the subarachnoid space. Therefore, when no slipped disc is found, the surgeon, before abandoning the operation, ought to search for such by carefully dissecting the *filum terminale* for them. (*Richard A. Leonardo, M.D.*)

CHRONIC BACKACHE IN COMPENSATION CASES

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CHRONIC backache is a very common problem in compensation cases. In slang parlance it is frequently a "headache" to the Labor Department, to the insurance carrier and to the physician. The paramount issue is the presence or absence of a competent and unequivocal physical cause; and if a cause is found, we must determine its exact pathology and relationship to the symptoms and the disability. When a cause is identified, the therapy is usually evident and not subject to much difference of opinion. The primary consideration is, therefore, the etiology. For this purpose the following factors are invaluable: (1) a knowledge of the patient's general condition and especially his physical competency prior to the alleged accident; (2) exact information about the nature of the injury and the type and degree of the immediate disability; (3) the course of the illness; (4) the nature of the treatment administered and its effect; (5) the physical findings directly or shortly after the injury; (6) a thorough physical examination of all the body systems including the various laboratory aids and (7) a combined consultative examination by a neuropsychiatrist and orthopedic surgeon.

The aforementioned comprehensive program of investigation not only offers the best opportunities for arriving at an accurate diagnosis but also has the special advantage that the honest patient will appreciate the efforts made in his behalf and cooperate toward his recovery. Also, the patient inclined to exaggerate his symptoms may realize that the thoroughness of the investigation is bound to disclose his dishonesty and he will likely accept the judgment of the physician to the advantage of all concerned.

I am not unmindful of the fact that some perfectly honest and well intentioned individuals may be so upset nervously that they unconsciously develop symptoms; backache may be one of them or perhaps even the only one which disables them. This type of case is one to be adjudged by a neurologist. That is why I believe that every difficult case of chronic backache should have a consultative examination by an orthopedic surgeon and a neurologist.

One of the greatest obstacles to the proper evaluation of symptoms and the disability, particularly in claimants seen months or years after the accident, is the frequent absence of accurate information of the physical status directly or soon after the accident. Many of the original examinations, judging from the stated findings, are so casual that no importance can be attached to the diagnosis. Diagnoses ranging from sprain to spondylolisthesis are made *without* a record of symptoms and signs to substantiate them. Formerly the most frequent diagnosis was sacroiliac derangement. Today it is herniated disc. Although the diagnoses may be made carelessly, they are high sounding and the claimant's attorney capitalizes on them, often harping at a hearing on the etiology, signs and symptoms of these or similar serious back lesions as if it had been proven that his client had such, although the medical examinations and testimony contain no evidence of any such condition. Manifestly inadequate medical examinations with unwarranted conclusions of serious illness confound and confuse the actual facts, sometimes to an absurd degree. I mention all this, which I am sure is common experience among so-called impartial specialists called upon for an opinion of the physical status of a patient one to ten years after the alleged injury, to emphasize the urgent need for thorough and accurate examinations directly or shortly after the accident. The insurance carrier would do itself and the claimant a great service if the original report of findings was carefully scrutinized by a physician who would promptly question the correctness of a diagnosis that was not substantiated by physical findings. Directly after an injury there is the least likelihood of distortion of facts and little thought on the part of the claimant to exaggerate complaints. As the months pass by, however, contemplation of opportunities for compensation leads to distortion of facts and persistence or the intro-

duction of imaginary complaints and disability. In all of this I am referring not to the generality of cases that constitute no problems, and with which we are not here concerned, but to the exceptional case which is nevertheless common enough to demand our special consideration. In this regard there can be no doubt that some laborers, particularly those without any intellectual interests, leading lives that include little else than work, eating and sleeping and little or no opportunity for respite from routine labor, may be inclined to capitalize on an accident and seek prolonged freedom from labor with compensation or perhaps even a substantial lump sum settlement. Our obligation as physicians confronted by a patient complaining of backache is to assume the presence of a real cause, organic pathology, to account for the complaint and to seek to identify it until we convince ourselves that there is none. Toward this end a knowledge of the original post-traumatic status is indispensable. I, therefore, make a plea for a careful if not exhaustive examination of the patient in the early days after the injury. From the monetary point of view alone it would pay the carrier to have an early, unbiased orthopedic opinion.

Prior to the strictly orthopedic investigation in any case of chronic backache the various systems of the body should be examined for the purpose of knowing whether there are any conditions other than orthopedic which might account for or be a contributing factor in the production of the backache. Of the various special systems attention should be directed to the following: (1) the genitourinary system; it is common knowledge that a ureteral calculus, a tumor of the kidney or bladder, a hypertrophied prostate and other pathologic conditions in this system are accompanied with pain in the back; (2) rectum; a neoplasm in or near the rectum and bleeding or thrombosed hemorrhoids may cause backache; (3) thorax; cardiac decompensation, an aortic aneurism or a lung tumor may give rise to backache; (4) abdomen; a neoplasm of any of the viscera, an abdominal aortic aneurysm, perirenal infections and so forth may manifest themselves by backache; (5) pelvis; uterine tumors and derangements frequently cause backache; (6) the nervous system; arachnoiditis, cord tumors, chronic degenerative cord lesions and others may cause backache; (7) systemic disturbances such as acute or chronic infections, secondary anemia, general physical exhaustion, obesity and the blood dyscrasias may have backache as an occasional or even an important symptom; (8) flat feet in adults is a competent cause for persistent backache.

When the foregoing items have been eliminated as potential factors, we proceed to an examination of the tissues of the back, that is, the strictly orthopedic phase. In this we must appreciate that the pathologic conditions may be in any tissue of the back from the skin to and including the retroperitoneal tissues. We should note all of the findings, preferably of several examinations, and then correlate them with the history, the course of the illness and all of the laboratory aids. Of the four methods of physical examination, only three are at present useful to us in investigating a backache, namely, inspection, palpation and percussion. Auscultation may in the future be helpful, as it is even now in determining the presence or absence of a fracture of a long bone, but it is not currently of much value.

The physical examination is as always begun by inspection. The patient should, of course, be completely undressed. It is instructive to observe him when he is undressing. Much can be learned about the appearance and mobility of the back, the presence of muscle spasm and often the presence or absence of pain on movements of the body. Normally the back is symmetrical, the spine is in the median line and the physiologic curve of the spine is unbroken. A change in these anatomic conditions such as a persistent lateral tilt of the trunk, a gibbus or a lateral curve indicates an existing pathologic disorder. The mobility of the spine varies in degree, being freer in the young than in the old patients and in the tall and thin individual rather than in the short, stocky or stout person. There is no absolute normal and the surgeon must use his experience and judgment in deciding the degree of mobility of the spine. One must be careful not to mistake hip motion for motion in the spine. Moreover, during flexion of the spine the lumbar lordosis should be visibly reduced or obliterated. If when a patient bends forward the lumbar spine remains flat and rigid, one must assume a lumbar pathologic disorder. In determining spinal motion it is helpful to steady the pelvis with one's hands and then have the patient move forward, backward and laterally.

Palpation is a most important means of investigation. Through this medium one can determine the presence or absence of muscle spasm, sensitivity to light and deep pressure, the quality and tension of the tissues, induration, tumefactions, bony prominences and irregularities and localized increase in heat. It is particularly important in eliciting tenderness that the examination be made slowly and carefully to identify its exact location and distribution and to determine whether the tenderness is present on superficial or deep pressure and is persistent or intermittent. Persistent localized tenderness is one of the most important physical signs of an underlying pathologic condition. Palpation, however, must never be casual. It may be used effectively in determining genuineness of complaint by simultaneously diverting the patient's interest as in inquiring about the nature of the accident or the cause of the symptoms about both of which compensation patients are inclined to talk freely—sometimes interminably.

Percussion in orthopedic surgery is really a form of palpation more particularly applicable to bony prominences and useful in eliciting tenderness in them.

In utilizing the various physical modalities mentioned one should bear in mind the anatomy of the back, remembering the deep fascia, the aponeurotic attachments of the muscles, various vertebral processes, apophyseal joints, ligaments and distribution of the lumbar nerves.

Roentgenography. The prerequisite for an interpretation of the x-ray findings is a knowledge of the normal roentgenographic anatomy of the back, the pathology in well known diseases of the spine and what might be called the normal senescent changes. Assume that a man thirty-five years of age falls and hurts his back and roentgenograms show a more or less extensive fusion of the vertebrae from an ankylosing spondylitis. It is manifest folly to attribute the spinal column disease to the injury. Or a short stocky laborer strains his back in lifting an inordinately heavy weight and the x-ray films show extensive so-called osteo-arthritis with numerous marginal spurs. Surely the injury did not cause the osteo-arthritis. The question of aggravation of symptoms is something that we must discuss. Generally speaking one should take at least anteroposterior, lateral and right and left oblique views for a thorough visualization of the vertebrae, their processes, the intervertebral articulations and the intervertebral discs. At the sacroiliac joints special views may be most helpful in disclosing existing disorders. Cone films and stereoscopic views are often helpful in discovering lesions in the articular processes and the laminas. Planographic studies have, in my experience, so far given little help in interpreting traumatic lesions. In the study of x-ray films it is a good plan to place them on the shadow box and then stand at some distance from them, say 4 or 5 feet, to get a general idea of the alignment, morphology and architecture of the vertebrae, their processes, size of the joint spaces, appearance of the articular surfaces, and the size, shape and structure of the intervertebral discs. Then a closer study can be made of the individual segments of the spine and the vertebrae. By this technic one is less likely to miss a mild spondylolisthesis, a linear fracture of a lamina, localized arthritis of apophyseal joints or synovitis of the sacroiliac joints.

Intervertebral Disc. The reader will recall that Thomas Dwight said that there was no normal fifth lumbar vertebra. This probably applies with equal truth to the lumbosacral intervertebral disc. We often see patients with normal spinal motions and no complaints in whom x-ray films show a reduction in the size of one of the lumbar intervertebral discs, especially the lumbosacral disc. A disc reduced in size does not *per se* indicate a pathologic condition, at least of clinical significance. Partial compression during motion is normal. Immobility when substantiated by a history of trauma and physical signs of derangement is significant. It has been shown that degeneration of the disc begins rather early in life and affects particularly the lumbosacral disc. A disc reduced in size may indicate only partial senescent deterioration and absorption. Not every disc that has degenerated herniates. Herniation of a disc is an important lesion and perhaps of frequent occurrence. Its diagnosis depends, however, not on finding a disc reduced in size but on symptoms and signs indicating that the disc became displaced and is causing pressure upon and irritation of one or more nerve roots. In recent years the diagnosis of a herniated disc has been made very frequently and often on inadequate evidence. My own criteria for the diagnosis of a herniated inter-

vertebral disc are as follows: history of a sudden onset of backache following trauma, mild or severe, recurrences of backache, associated sciatic pain, evidences of irritation of the sciatic nerve and hypesthesia in the distribution of some of its constituents, and myelography indicating extrusion or bulging of a part of the disc with pressure on one or another of the lumbar nerve roots.

When the diagnosis is certain, I am against immediate operation unless the symptoms are inordinately severe. Conservative orthopedic treatment should be instituted first because so often under adequate rest and immobilization the symptoms subside and the disability disappears. Moreover, good operative results are obtained in only 65 per cent of the cases. Recurrences have been seen and reported after successful operations. The operation is one of considerable magnitude and should be undertaken only when imperative (i.e., when conservative treatment has failed) and then only by those qualified to perform it since the inexpert or inept surgeon can do much damage. I hasten to add, however, that when a disc herniation persists and is causing pain and disability, there should be no hesitancy in its surgical removal.

Apophyseal Joints. I am of the conviction that we have not paid sufficient attention to these very important although small joints. Their structure is identical with that of other joints, hence, they are subject to pathologic disorder arising from trauma, toxic and metabolic disturbances and infections. Trauma is a relatively common cause of localized arthritis. The injury may initiate chondromalacia of the articular cartilage as it does in the knee. Trauma may cause a linear fracture of an articular process with a disturbance in joint function. A twist of the back or lifting an inordinately heavy weight may give rise to a sprain of the joint, hemorrhage into it or synovitis just as it often does in the ankle. When the joint is the seat of a pre-existing disease such as osteo-arthritis or rheumatoid arthritis an injury can certainly aggravate the condition as it would in the hand or hip joints. The triad of signs we must depend upon for a diagnosis consists of localized pain, localized tenderness and roentgenographic pathology. Not all three elements are always present. The x-ray film may be negative, yet the other elements plus a history of local injury and immediate disability make the diagnosis certain. In lesions of the apophyseal joints cone x-ray films are particularly useful.

The common lesions of the back with which we are confronted in compensation cases, as well for that matter in non-traumatic cases, are summarized in Table 1.

TABLE 1
COMMON CAUSES OF BACKACHE

- Faulty posture
  - General and persistent attitude of relaxation
  - Round shoulders
  - Hollow back
- Vertebral epiphysitis
  - Dorsal spine: kyphosis
  - Lumbar spine: flat rigid back
- Derangement of soft tissues
  - Myalgia
  - Myositis
  - Myofascitis
  - Fibrositis
- Sprains
  - Lumbosacral joints
  - Sacroiliac joints
  - Lumbar apophyseal joints
- Sciatica, idiopathic
- Sciatic scoliosis arising from lesions in the fascia, muscles or ligaments of the back or buttocks, lesions of the intervertebral joints or discs
- Herniation of intervertebral disc
- Spondylolisthesis
- Congenital laminar defects
- Vertebral osteoporosis
- Structural scoliosis
- Inflammatory lesion of the spine and pelvis
  - Specific:
    - Tuberculous
    - Luetic
    - Typhoid
    - Gonorrheal
    - Pyogenic, osteomyelitis
    - Colon bacillus
    - Influenzal
  - Non-specific:
    - Osteoarthritis
    - Rheumatoid arthritis
    - Spondylitis deformans
    - Traumatic
    - Degenerative arthritis without spur formation
- Metabolic and endocrine disturbances such as Paget's disease
- Fractures of spine
  - Body of vertebra
  - Processes of vertebra
  - Laminas
- Dislocation and subluxation of vertebra
- Tumors of spine
  - Benign as cyst of spinous process
  - Malignant: primary and metastatic

There is no need of analyzing the signs and symptoms of each lesions. Some are directly the result of trauma such as fractures; others

antedating the trauma are unquestionably activated or aggravated by an injury and in that sense are compensable. I should like to direct the reader's attention particularly to the fractures of the vertebral processes, especially the articular processes and laminas. These are frequently overlooked in large films of the spine. Cone pictures are always desirable. The fractures are characterized by two special features, namely, they are usually linear with no displacement of fragments and healing may be delayed for months and even years. Fractures of the articular processes show up best in anteroposterior views while laminar fractures are more readily recognized in oblique views. It is in this type of lesion that careful scrutiny of the x-ray films serves to establish an otherwise easily missed diagnosis.

Aggravation of Pre-existing Pathology. It can, I think, be readily appreciated and must therefore be admitted that trauma imposed on a spine that is the seat of rheumatoid arthritis, osteo-arthritis, spondylolisthesis or a congenital laminar defect (sometimes called prespondylolisthesis) can so stretch the ligamentous and muscular attachments as to give rise to minor tears and hemorrhages so that areas previously insensitive become painful and disabling; and since the spine and tissues of the back are more or less in constant motion, the damage resulting from the accident has inadequate opportunity for repair. Hence the disability, mild or severe, may be prolonged and become chronic. It must be emphasized that because an osseous lesion is congenital or has been in existence for a long time a traumatic disability referred to it cannot be disregarded; yet the mere presence of spondylolisthesis or chronic extensive osteo-arthritis is no warrant for imposing a financial burden on the carrier. The point at issue is the determination of the existence and degree of disability. If the claimant with chronic osteo-arthritis of the spine had, prior to the injury, been able to carry on heavy labor and had had no discomfort, but after the injury has backache and is unable to do laborious work, and the physical examination indicates irritation of the spine by the presence of restricted mobility, tenderness and muscle spasm, we can unqualifiedly say that the pre-existing disease has been aggravated by the accident. For such a determination it is helpful to make several examinations; observe the patient in a hospital and, more particularly, study the patient's activity when he does not know he is being observed. Herein lies the importance of a thorough history at the time of the injury to learn all about the claimant's physical status prior to the accident. In relation to aggravation of pre-existing disease we must carefully analyze and correlate the following: temperament of the patient, nature of the pre-existing pathologic condition, type, severity and duration of the injury, course before and after the accident and physical and laboratory findings.

Neurogenic Backache. I hesitate to use this term because it is difficult to diagnose it accurately; yet we must admit that now and again the physician in a careful, methodical and sympathetic study of the patient is convinced that there is no underlying organic pathologic disorder. The patient's symptoms are bizarre, do not correspond to known syndromes and do not fit into any definite pathologic picture; in fact, by their peculiar character and distribution, the symptoms appear to be a figment of the imagination adduced consciously and deliberately or appearing unconsciously and without premeditation by reason of an unstable nervous system. In such cases it is our bounden duty to express ourselves in no uncertain terms and leave it to the Referee to dispose of the case in accordance with his interpretation of the situation and the dictates of the compensation laws.

We physicians are keenly aware that there is much we do not know about the morphology, physiology and function of bones, muscles and joints; yet by a careful history and examination of the patient suffering from chronic backache, availing ourselves of all the laboratory aids, we can come very close to an accurate diagnosis of its etiology and plan the most effective therapy.

I have reviewed fifty cases of chronic backache in compensation cases removed from my files at random. The patients were seen during the last seven or eight years. Of these fifty cases, which undoubtedly represent a cross section of the very many more I have seen in the last thirty years as an impartial orthopedic advisor to the Labor Department, thirty-three were male, seventeen female. The ages varied from twenty-one to sixty-three years with an average of 41.3. There were twenty-two occupations varying from a jeweler to a truck driver. The duration of the backache varied from one to seven years. The diagnoses made were chronic sprain, seventeen cases;

Pott's disease, one; arthritis, six; herniated disc, six; laminar fracture, one; laminar defect, one; spondylitis deformans, one; osteo-arthritis, two; sciatic scoliosis, two; vertebral body fractures, two; neurosis, one and negative, ten. A study of these figures shows that in 34 per cent the patients were suffering from a soft tissue injury involving muscles, ligaments or fascia. The pathologic condition was chronic and accounted for the persistent disability which is in accordance with our experience that many, perhaps most, traumatic lesions in the back heal very slowly.

There were only six cases or 12 per cent in which the diagnosis of a herniated disc was fairly reasonable. There were six cases or 12 per cent of localized lumbar arthritis, meaning involvement of the apophyseal joints. There were ten cases or 20 per cent in which no disorder could be found. This is the group in which there is either conscious exaggeration (i.e., malingering) or, to speak generously, an unstable nervous system. This is the group which the Referee must settle according to his best judgment having the knowledge and backing of a negative medical examination.

There was a fairly large number of pre-existing but contributing factors such as lumbar arthritis, spondylolisthesis, a healed fracture of a transverse process, osteo-arthritis, senescence, obesity, faulty posture, disease of the spinal cord and pre-existing neurosis. It is often difficult to evaluate what portion of the disability is due to the effects of the trauma and what percentage to the pre-existing derangement. Herein lies the element of judgment, and each of us must give an opinion based on knowledge, logic and experience.

As previously stated, recovery from a traumatic lesion of the back is likely to be delayed, and for the following reasons: (1) multiple lesions; it is understandable that if a man sustains a strain of the lumbosacral fascia and a sprain of several lumbar joints, including perhaps the sacroiliac joints, his convalescence may be retarded for months or even years; (2) patients of advanced years; it seems only natural to believe that the tissues of a man of sixty are less resilient and not likely to heal as rapidly as those of a man of thirty years of age; furthermore, the tissues of a hard working man as a laborer do not heal as fast as those of a young saleslady; (3) patients with previous pathologic conditions such as osteo-arthritis, spondylolisthesis and congenital laminar defects; in these conditions we repeatedly see chronic disability sometimes requiring surgery. (4) fractures of the laminas and articular processes; it is difficult to explain why these fractures, usually only linear with no separation of fragments, heal slowly; but they do so and we must be alert to such lesions as they are easily overlooked; (5) patients with previous back injuries; chronicity and severity of disability are found in direct proportion to the number of injuries; the situation becomes very difficult, particularly in any attempt to apportion degrees of the disability due to the various accidents; (6) frightening diagnoses; patients whose injury was unwittingly magnified by the use of serious-sounding medical terms (e.g., "broken back" for a simple linear fracture of a transverse vertebral process) may be terrified and precipitated into a state of extreme although unwarranted disability; I have seen much mental distress and physical incapacity as sequels to scientifically accurate but unfortunate and ill advised terminology; (7) nervous temperament; we all have seen anxious and self-centered patients who are so apprehensive when subjected to illness or injury as to retard unintentionally and without maliciousness their complete recovery.

The question then arises of what we as physicians can do to guard against or prevent a prolonged convalescence. I believe we can help a great deal by doing the following: We must make a thorough examination soon after the injury to establish a definite diagnosis. Accurate and adequate treatment should be instituted promptly. Discourage exaggeration of symptoms by the patient. Avoid the use of frightening diagnoses. Utilize early consultations. Avoid unduly prolonged treatment, especially physical therapy.

COMMENTS

Chronic backache in compensation cases is a special problem which can best be met by a thorough appreciation of its many causes and, particularly, the influence of trauma on a pre-existing pathologic disease in the back. Care must be exercised to discover all contributory factors, especially lesions in the various tissues of the body elsewhere than in the back. Last but not least, the physician must not only utilize his knowledge of tissue pathology and the treatment for its eradication but also must apply careful and sympathetic understanding to the psychologic management of a patient who has a chronic backache.

METHOD OF TREATMENT OF BENNETT'S FRACTURE DISLOCATION*

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THE difficulties of obtaining anatomic reduction and the disability of the hand that results from inadequate primary treatment of Bennett's fracture warrant a consideration of the methods available by which satisfactory results can be expected. It is the purpose of this article to suggest as primary treatment a modification of the Bunnell method of correcting malunion of this type of fracture. Excellent results have been realized in a small series, and ease of reduction and convalescence seem to recommend the procedure.

Certain anatomic features of the thumb metacarpal-carpal joint must be kept in mind to understand fractures involving the joint and their treatment. Stability is sacrificed to allow the extra motion necessary for opposition of the thumb and, in common with the fifth metacarpal bone, the first articulates with only one carpal bone. This instability is further abetted by the pull of the abductor pollicis longus which inserts into the base of the first metacarpal. It appears that only one anatomic feature is responsible for the integrity of the joint and that is the volar lip or "hook" on the concave articular surface of the metacarpal, located opposite the insertion of the abductor tendon. In the usual Bennett's fracture this "hook" is sheared off, forced distally, and subluxation of the shaft and remaining articular surface of the metacarpel results in response to the unapposed tension of the abductor tendon. The "hook" remains in a normal position as related to the joint, held in place by the attached capsule. Simple abduction and pressure to correct the subluxation does not overcome the displacement of the "hook" and although traction will produce a reduction with restoration of the normal articular surface, end results will not be good unless the traction is carefully watched, readjusted and check films made at regular intervals.

Certain complications are encountered frequently enough with the aforementioned method to lead one to seek more satisfactory means of treating this fracture. First, the traction pin should be placed in the distal metacarpus to avoid traction through the proximal thumb joint which tolerates traction very poorly. A pin in this area functions with difficulty because of the adjacent mobile thumb web; and since complete immobilization is not realized, soft tissue motion about the traction pin often produces a troublesome secondary infection. Secondly, the pressure over the metacarpal head to maintain reduction and apposition at the fracture site may often be sufficient to produce a necrosis of the overlying skin. The same complication will result on the flexor aspect of the thumb if the cast is used to maintain the metacarpus in abduction. Lastly, the exact reduction necessary is difficult to demonstrate by roentgenography because of the overlying plaster so that adjustments of the traction can hardly be effectual.

Unless an anatomic reduction with accurate restoration of the "hook" is achieved, the hand loses considerable strength in grasp and use of the thumb in pinch, and opposition is seriously interfered with because of chronic subluxation of the joint. Furthermore, the joint becomes progressively more painful and a traumatic arthritis appears. Arthrodesis then becomes necessary. Bunnell's corrective osteotomy for malunion of this fracture will give excellent results if performed early before the onset of the traumatic arthritis. It is a difficult operation, however, and unless done with a minimum of trauma, will precipitate an arthritic process which necessitates arthrodesis in spite of restoration of the volar lip. Therefore, early primary reduction is important.

Operative Procedure. The patient's arm and hand are prepared and draped in the usual manner for an open reduction. Under the ischemia of a pneumatic tourniquet and local

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1 2

FIG. 1. A typical Bennett's fracture; note the tendency for the shaft to displace in response to the abductor pollicis longus.
FIG. 2. Fracture reduced and "hook" restored by a single Kirschner wire; open reduction was not required.

block anesthesia, the fracture dislocation is reduced by traction and abduction of the metacarpal bone. Reduction is maintained while a Kirschner wire is driven through the base of the metacarpus into the greater multangular. Routine x-rays are then made without contaminating the field; and when the fracture dislocation is anatomically reduced, the pin is bent at an angle to prevent drifting, buried beneath the skin, and a plaster cast applied incorporating the thumb in abduction with dorsiflexion of the wrist. The distal phalanx of the thumb is allowed to remain free. (Figs. 1 and 2.)

If reduction is not satisfactory, the pin is removed and the metacarpal-carpal joint is exposed through an incision along the dorsal radial aspect of the first metacarpal bone, curved along the flexion crease of the wrist. The thenar muscles are stripped away subperiosteally and the capsule incised exposing the fracture site. Under direct vision the metacarpal head is brought up to the smaller volar lip fragment, and a Kirschner wire is inserted through the head of the metacarpus into the greater multangular in order to maintain the reduction. If any difficulty is experienced in maintaining anatomic apposition of the fragments by this single pin, Bunnell's method after corrective osteotomy, using crossed pins between the two fragments, should be utilized in addition to the third pin through the joint. It would appear this is rarely necessary, however, except when the head is comminuted and several fragments are present. In such a case, experience indicates, a primary arthrodesis is probably the best primary procedure as end results are uniformly poor regardless of the method of treatment.

Pins are bent to prevent drifting, cut short and buried subcutaneously to facilitate removal. After four weeks they can be removed under local anesthesia but immobilization should be continued until union is solid by x-ray, usually a total of eight weeks. Rehabilitation should be assisted by an active exercise regimen after removal of the cast.

The advantages of such a method of reduction in the primary treatment of this type of fracture are obvious. Reduction is anatomic and is maintained without danger of pressure ulceration or pin suppuration and without the constant supervision traction necessitates. The distal phalanx of the thumb is free to exercise the long flexor and extensor tendons and active use of the hand during the period of immobilization made possible. This allows an early return to work with a minimum of lost time. The operative technic is relatively simple, certainly as simple as obtaining and maintaining reduction by traction, and with ordinary surgical technic complications are not encountered.

SUMMARY

A method of treatment of Bennett's fracture dislocation utilizing a modification of Bunnell's corrective osteotomy for malunion of this fracture is presented. The procedure has certain advantages over the traction method of treatment, is relatively simple and has produced uniformly good results in a small series of cases, with a lower incidence of complications and malunion.

SIMPLIFIED TECHNIC FOR CLOSURES OF THIN, FRIABLE HERNIAL SACS

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NOT infrequently in the repair of an inguinal or femoral hernia the surgeon is presented with a very thin and exceedingly friable sac. This condition is frequently encountered in young boys who have a congenital hernia associated with cryptorchidism. This method, although very satisfactory in fairly strong or thick sacs, has the following disadvantages in thin friable sacs: Every passage of the needle, even an atraumatic needle, weakens the line of closure and sometimes the needle puncture is the start of a tear in the thin friable

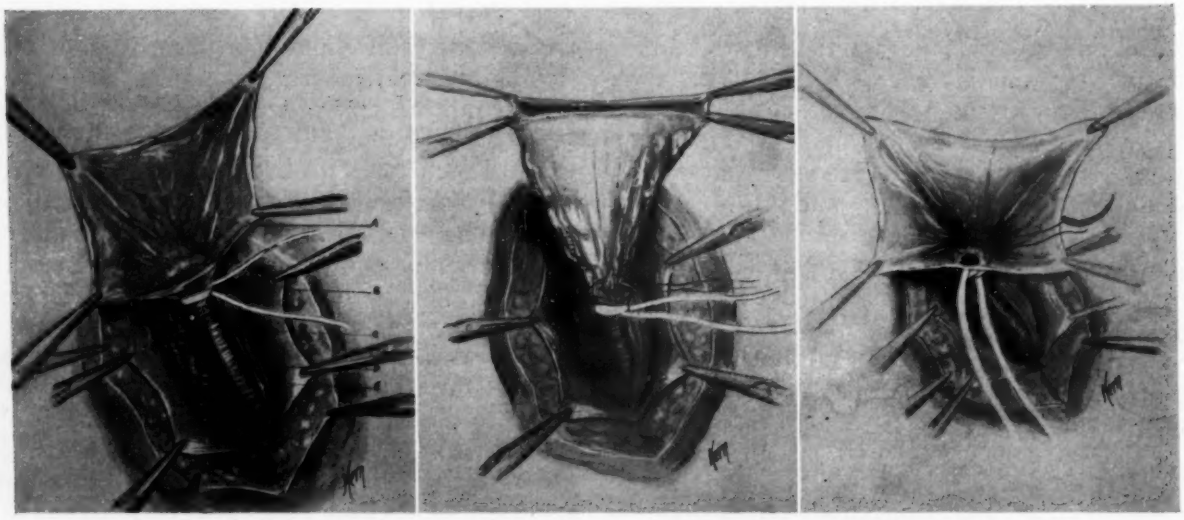

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FIG. 1. Medial inferior aspect showing neck in process of tying off with umbilical tape. A, peritoneal sac; B, fascia of external oblique; C, floor of canal; D, conjoined tendon; E, cord.
FIG. 2. Umbilical tape applied at neck.
FIG. 3. Neck of sac closed off by tape; purse-string suture effected.

One of the more common methods of handling this situation is to twist the redundant portion of the sac upon itself and then to apply the suture ligature at the thickened, reenforced base. Occasionally, in this method a piece of omentum or even a nipple of gut may be caught in the twist. This necessitates a repetition of the procedure in order to exclude the presenting omentum and gut. The suture is then transfixed at the base, ligated, and the redundant portion of the sac is excised. This method is blind, to a certain extent, because a piece of omentum may be snared in the transfixion and the unwary surgeon may not be cognizant of this fact. Another fairly satisfactory method is to purse-string the neck of the sac from within, under direct vision. peritoneum. This renders a closure even more difficult.

The following method of closure, we believe, is simple, effective and offers the advantages of the preceding two methods with none of the disadvantages. We call it the "temporary tape tie technic."

The sac is dissected free from the surrounding structures down to its base by whatever method the surgeon prefers. The opening in the sac is then prolonged along its superior surface for a short distance, allowing at least 2 to 3 cm. intact at the base. Suitable traction is applied to the sac and a piece of narrow tape (umbilical) is tied around the base with either a slip-knot or a single knot. This temporary tie can be effected

easily and placed as high as the surgeon thinks necessary. Protruding omentum or gut can be kept from the closure with a hemostat or other suitable instrument. Even if a small piece of omentum is caught in this temporarily closed neck, it does not matter. The next step is to transfix the thickened, bunched sac immediately distal to the tape tie. This can be done under direct vision, (the caught piece of omentum excluded) and the procedure is not hindered by the effects of respiratory movements or the straining of the patient because the neck is closed off by the temporary tie. After the transfixion suture is secured, the tape can be removed easily and the redundant portion of the sac excised. A heavy chromic suture may be substituted for the tape. (Figs. 1, 2 and 3.)

Another point which we have found useful is in the method of opening a thin friable sac. We like to incise the sac on its superior (or lateral) surface instead of the inferior (or medial) surface. We think that if the hernial sac should tear or split while using the inferior approach, the inferior epigastric vessels, the bladder, the floor of the inguinal canal and the occasional abundant properitoneal fat in this area might give the surgeon some difficulty, whereas if the superior incision is used, such a tear or split in the peritoneum would approach no important structures and the tear can be more easily handled.

OCCASIONALLY a surgeon encounters a cyst close to the rectum and is unable to explain its origin. Often the cyst may not even cause symptoms. The positive diagnosis of enterogenous cyst can be made only after histologic examination of the wall of the excised specimen. Although there is discussion concerning their etiology, a fair explanation considers them arising from remnants of the tail gut, just as cysts occasionally arise from remnants of the vitelline duct. (*Richard A. Leonardo, M.D.*)

METHACRYLATE BALLS IN EXTRAPLEURAL PNEUMONOLYSIS*

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THE number of cases of extrapleural pneumonolysis with methacrylate plombage which have been reported is still so small that the report of one such a case is worthy of presentation.

Since 1891 when Tuffier first described extrapleural pneumonolysis, surgeons have been seeking for a non-exciting material which could be used to maintain the lung in a collapsed state. Tuffier's use of the patient's own fatty tissue as a filling for the dead space was soon discarded because of the difficulty in excising the tissue and because the tissue soon liquefied. Numerous other materials such as paraffin, plain gauze, pectoral muscle, pneumatic bags and air were subsequently tried to fill the dead space. However, the late results revealed a high incidence of infection of the space, perforation of the cavities into the space and difficulty in dealing with the permanent dead space after pulmonary healing was complete. Many times the packing had to be removed and a thoracoplasty was necessary to obliterate the space.

Because of the excellent results of extrapleural pneumonolysis with lucite plombage reported by Wilson and Baker in 1946, interest has been revived in a procedure which has a great deal to offer in the treatment of tuberculous patients. The methyl ester of methacrylate is a plastic manufactured from hydrocarbons in the presence of sulfuric acid. This product can easily be molded into hollow, lightweight spheres 1 inch in diameter, is readily available and inexpensive. It was therefore thought that this might be an ideal medium to maintain the collapse. It produces very little inflammatory reaction; and although a small amount of serum may accumulate, it rarely requires aspiration and is soon converted into a thin film of connective tissue. The balls do not interfere with the roentgenographic interpretation of later films. Plastic balls permit selective collapse of any portion of the lung with preservation of good lung tissue. They lessen the danger of spread by stabilizing the mediastinum and cosmetically maintain normal chest contour. Patients who would seem to benefit most by this procedure are those who have an apical lesion so situated and so localized that a local collapse will prevent spread of the disease and possibly aid cure of it when the area is collapsed. However, it should be used only if the adhesions between the visceral and the parietal pleura are so extensive that an intrapleural pneumothorax even supplemented by intrapleural pneumonolysis will not satisfactorily collapse the area of lung to be collapsed.

The possibility of successful production of the extrapleural air pocket depends upon the absence of too firm adhesions between the parietal pleura and the chest wall. A very chronic condition with extensive or very dense lesions, especially with large cavities near the periphery, is therefore a contraindication. In such cases there may be no line of cleavage in the endothoracic fascia so that separation is practically impossible; or the danger of rupture of a thin walled cavity, either during operation or later, is great; also, in thick cavities it may be impossible to produce collapse even with positive pressure. In these conditions thoracoplasty is likely to be safer and more efficient.

CASE REPORT

In 1931 Mrs. M. A., while in training as a student nurse, developed a left pleural effusion. This was aspirated and smear and culture of the fluid were reported as negative for tuberculosis. In 1934 the patient had hemoptysis. A roentgenogram taken at that time revealed a small cavity in the right upper lobe. The sputum was still negative. She was sent to a sanatorium for three and a half months and was discharged as an arrested case. She remained at home. In 1937 in a routine check-up a roentgenogram revealed bilateral tuberculosis confirmed by positive sputum. She then returned to the sanatorium at bed rest for six months.

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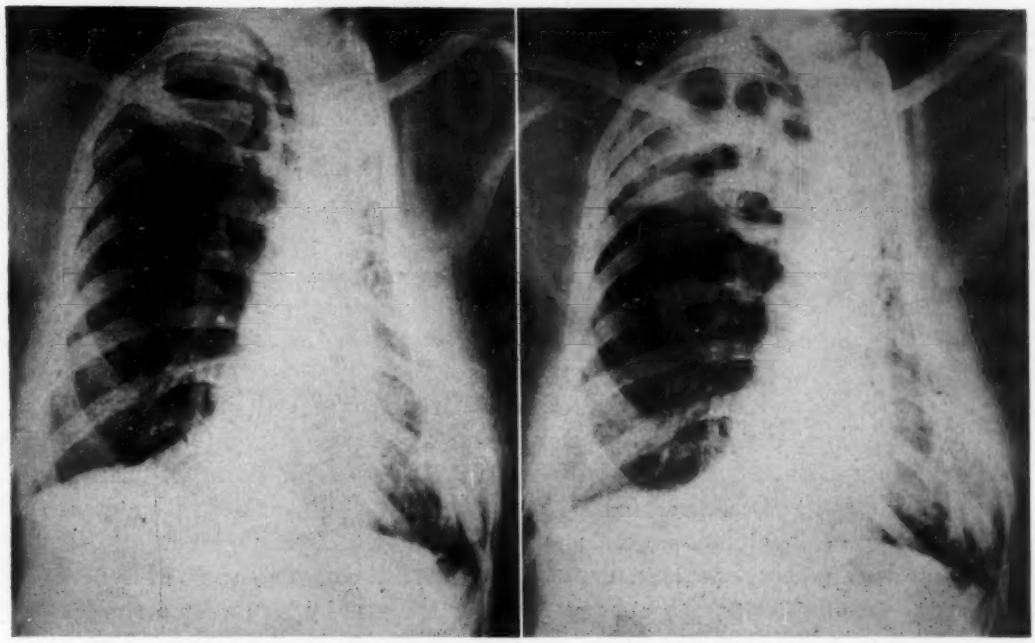

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FIG. 1. Film taken March 1, 1948, reveals fibrosis and cavitation in the upper portion of the right upper lobe. The cavity measures approximately 4 cm. in diameter and is surrounded by a thickened pleura. The thoracoplasty on the left side shows good collapse of the left lung.
FIG. 2. Film taken on April 12, 1948, reveals that posterior portion of the fourth rib posteriorly has been resected. There are many lucite balls in the upper portion of the right lung with compression of the apex. The previously mentioned cavity in the right upper lobe is not present at this time.

A left phrenic crush and a right pneumothorax with lysis of adhesions were done at this time. The cavity, however, continued to enlarge and the pneumothorax was discontinued. Pneumoperitoneum was now instituted. At the end of 1939 she was discharged from the sanatorium with positive sputum. The officials at the sanatorium did not recommend a thoracoplasty because they thought that the patient was too frail to withstand the procedure. In 1941 she had a pneumonic spread bilaterally and pneumoperitoneum was continued until June, 1941. In that month she had a four-stage left thoracoplasty. Her sputum became negative and she was discharged in September, 1942. She remained at home until September, 1946, when her sputum was once again positive and she returned to the Philadelphia General Hospital. X-ray at this time revealed a large cavity in the right apex. (Fig. 1.) She remained at bed rest until March, 1948, but her condition steadily became worse. Since nothing else could be offered the patient, it was thought worth while to attempt to collapse the cavity with methacrylate packing. (Fig. 2.)

Under cyclopropane endotracheal anesthesia with the patient in the prone position, a 1½ inch segment of the right fourth rib was removed posteriorly. The parietal pleura was easily stripped from the endothoracic fascia down to the sixth rib posteriorly and to the fourth rib anteriorly. No bleeding was encountered. Thirteen balls were required to fill the space. Several trial arrangements of the balls were necessary before a pattern was found that eliminated rattling of the balls with respiration. The wound was closed in layers with interrupted sutures of No. 30 cotton.

The patient felt better for several months after the operation and the sputum steadily decreased in amount. However, at this writing the amount of sputum has increased to 1 ounce daily and has remained positive. Bronchoscopy reveals tuberculous tracheobronchitis. Although it was not possible to convert the sputum, it is thought that at least further spread of the disease was retarded.

COMMENTS

It is conceivable that the described procedure may be used to collapse an entire lung thereby producing more adequate collapse and at the

same time maintaining normal chest contour. In general, application of the procedure will depend upon the long term results obtained with the use of methacrylate balls.

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Rogers and Keating report four new cases of primary hypertrophy and hyperplasia of the parathyroid glands and review the literature. This condition must not be confused with parathyroid adenoma (with its characteristic clear cells), with secondary parathyroid hyperplasia nor with metastatic renal cell carcinoma occasionally found in the thyroid gland.

Clinically, these patients usually present all the obvious signs of hypersecretion of their parathyroid glands and they really represent a similar condition, physiologically and pathologically, as do patients with Grave's disease (i.e., primary hyperthyroidism) except that the "site" of the disease is in the parathyroids instead of in the thyroid gland. Obviously, therefore, similar etiologic factors may be present in both diseases.

It will be interesting to see if someone discovers a preparation like thiouracil which has the power of preventing the excess formation of parathyroid hormone that is a characteristic and persistent finding in all cases of primary parathyroid hyperplasia. (*Richard A. Leonardo, M.D.*)

Streamlined Articles

ACUTE SEMINAL VESICULITIS SIMULATING APPENDICITIS*

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ACUTE seminal vesiculitis is capable of producing abdominal symptoms that are readily confused with acute appendicitis. Acute seminal vesiculitis is more frequently confused with appendicitis than any other disease. As early as 1893 Fuller described intestinal colic associated with seminal vesiculitis. Strangely enough, this syndrome seems to have dropped from general notice. An occasional paper has been published on the subject but it remains unrecognized as a possible source of confusion with appendicitis. In dealing with predominantly male patients as we do in the Veterans Administration, acute seminal vesiculitis must receive consideration in the differential diagnosis of any acute abdomen.

* * * *

Acute seminal vesiculitis is characterized by a sudden onset and a brief, self-limited course. The acute pain in the abdomen rarely lasts more than twenty-four hours and never more than forty-eight. Leukocytosis may or may not be present and the urine is characteristically normal. In those cases in which pyuria develops it occurs after the acute symptoms have subsided. Acute seminal vesiculitis is a syndrome and may be due to any one of several causes. Neisserian infection is seldom, in our experience never, the causative factor. The most consistently reported etiologic factor is a change in sexual habits. It seems that acute engorgement of the seminal vesicle, without infection, can produce the symptoms and can be precipitated by enforced abstinence as well as sexual excesses. This concept has been developed by previous writers on this subject. Although the normal seminal vesicle may be difficult or impossible to palpate, we have found Guilliot's observation in 1883 still to be true, that the diseased seminal vesicle is always palpable.

The differential diagnosis of this condition from acute appendicitis is not difficult if a careful history is taken, careful physical examination done and adequate rectal examination included. The history is always atypical for appendicitis. The pain is usually localized to the lower abdomen from the onset. Nausea and vomiting are only rarely experienced. A history of venereal disease is seldom obtained. On physical examination the abdomen is found to be soft with no suggestion of muscle guard or spasm. Rebound tenderness and other signs of peritoneal irritation are absent. Tenderness is at a maximum below McBurney's point and usually immediately above Poupart's ligament on one side or on both. The white count is usually low but it may be elevated in an occasional case. The urine is characteristically normal in the beginning but pyuria may develop after the acute symptoms subside. The rectal examination is diagnostic. Any rectal examination should include an attempt to palpate the seminal vesicles. If they are diseased, they will be found lying above the prostate and below the bladder as tender, moderately firm, finger-shaped structures. Most important, pressure on the palpable seminal vesicle will reproduce or aggravate the abdominal pain of which the patient complains. A comparative study of ten cases of acute seminal vesiculitis has been made and charted to illustrate the clinical symptoms. (Table I.)

COMMENTS

It will be noted that seven of the ten patients were admitted as having acute appendicitis. Case VIII had no admitting diagnosis since the

* From the General Surgical Service of the Veterans Administration Hospital, Lincoln, Nebr. Sponsored by the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are a result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

TABLE I

Case	Age (yr.)	Race	Marital Status	Admission Diagnosis	Discharge Diagnosis	Localization of Pain	Nausea and Vomiting	Progress and Duration of Acute Symptoms	Muscle Spasm	Rebound Pain	Palpable Tenderness	Rectal Examination	Leukocytosis (White Blood Cells)	Urinalysis
I B. B.	24	White	Married	Acute appendicitis	Acute seminal vesiculitis	General abdominal pain localizing in right lower quadrant	Neither	Acute 48 hr.	None	None	In both lower quadrants	Marked tenderness of seminal vesicles	7,950 7,700	18–20 RBC/HPF Gram stain—neg. 15–20 RBC/HPF 15–20 WBC/HPF
II D. L.	22	White	Married	Acute appendicitis	Acute seminal vesiculitis	General abdominal pain localizing in right lower quadrant	Nausea at onset	Subacute 48 hr.	None	None	Mild in both lower quadrants	Tenderness of seminal vesicles	15,600 13,900 9,450	Negative Negative Negative
III W. W.	25	White	Married	Acute appendicitis	Acute seminal vesiculitis	Right half of abdomen	None	Subacute 24 hr	None	None	None	Right vesicle indurated and tender	7,800 5,600	Negative Negative Negative
IV E. W.	38	White	Single	Acute appendicitis	Acute seminal vesiculitis	General abdominal pain localizing in right lower quadrant	Nausea	Acute ?	Voluntary	None	Deep in right lower quadrant	Seminal vesicles very tender	13,400 16,850 14,700	Few WBC 30–50 WBC/LPF Culture sterile
V F. W.	37	White	Married	Acute appendicitis	Acute seminal vesiculitis	Right lower quadrant only	None	Acute 48 hr.	None	Yes ?	None	Seminal vesicles tender	9,500	Negative Negative
VI R. S.	21	White	Married	Subacute appendicitis	Acute seminal vesiculitis	Right lower quadrant only	None	Chronic with acute episodes ?	None	None	Right lower quadrant	Seminal vesicles tender; pressure on right vesicle produced abdominal pain	7,500 7,800	Negative Negative
VII F. S.	27	White	Married	Appendicitis or gastroenteritis	Acute seminal vesiculitis	Right lower quadrant only	None	Acute 24 hr.	None	None	Deep in right lower quadrant	Left seminal vesicle tender	8,200	20–40 WBC Numerous WBC B. Coli and gram + diplococci
VIII M. G.	29	White	Married	None	Acute seminal vesiculitis	Left lower quadrant only	None	Acute 48 + hr.	None	Yes ?	Left lower quadrant	Seminal vesicles tender; pressure on left vesicle produced abdominal pain	4,800 7,600	Negative
IX M. H.	31	White	Married	Psychoneurosis; possible organic lesion	(1) Anterior urethritis; (2) acute seminal vesiculitis	None	Psychogenic	Chronic ?	None	None	None	Left seminal vesicle indurated and tender	8,800 8,100 10,600	Negative Negative Negative
X A. P.	52	White	Single	Possible pyelitis	(1) Prostatitis; (2) seminal vesiculitis	Right costovertebral angle	None	Subacute	None	None	None	Seminal vesicles tender	6,000	10–12 WBC Many WBC Culture sterile

patient was seen directly and not by referral. The last two cases are atypical in that they probably represent an ascending infection rather than simple congestive vesiculitis. It is interesting to note that in three of the cases the pain started as a generalized abdominal pain and localized in the right lower quadrant after a few hours. Vomiting was never seen in any of these cases and nausea in only two. In all cases the progress was that of an acute disease and symptoms usually subsided in forty-eight hours. In Case IV a question mark is placed after acute because this man was subjected to a laparotomy because of his high white count. Therefore, it was not possible to evaluate the duration of his abdominal symptoms. Muscle spasm and rebound pain are characteristically absent. Cases V and VIII in which the examiner stated that he found rebound pain, are questioned. It is not probable that true rebound pain was present in the absence of muscle spasm. As previously mentioned the rectal examination was diagnostic. Laboratory findings are of little assistance since the white count may vary from a normal to a high count. Usually, however, leukocytosis is absent. The urinalysis is characteristically negative; and if pyuria develops, it is usually noted in the second or third specimen.

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TREATMENT OF HEMOTHORAX*

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IN this article one hundred seventy-one cases of civilian chest injuries complicated by hemothorax will be reviewed. Comparison of those cases in which the chest was kept "dry" by early aspirations with those in which there was delayed or insufficient removal of the blood, by the criterion used, indicates that early and repeated aspirations of the blood reduced the duration of fever and hospitalization.

Approximately 70 per cent of the deaths occurred within the first twenty-four hours after admission so that more emphasis should be placed on emergency treatment.

* * * *

Hemothorax is a common complication of all types of chest wounds. There is some difference of opinion as to the correct form of treatment. Among the recommended therapies are early thoracotomy,[1–3] expectant "watchful waiting" treatment,[4] aspiration of the blood and replacement with air,[5–24] and aspiration of the blood without air replacement.[25–29] Judging from the experiences during World War II with frequent evacuation of the blood without air replacement, this seems preferable in war casualties.[25–29]

We have reviewed the cases of chest wounds complicated by hemothorax in local civilian institutions in an effort to ascertain whether or not early aspiration was beneficial. The cases studied were those of 171 patients with hemothorax admitted to the Jefferson Davis, Hermann, Memorial and St. Joseph's Hospitals in Houston, Texas, between January 1, 1944, and January 1, 1949. Any patients in whom the blood was removed within seventy-two hours after injury and whose chests were kept "dry" by frequent thoracentesis were classified as having had sufficient aspirations. Any patients in whose chests blood accumulated and was not removed for seventy-two hours were considered not to have had sufficient aspirations. In order to ascertain the effect of treatment on different quantities of blood in the thorax it was decided to classify the cases into the following three groups: small hemothorax if less than 300 cc. of blood were present, as judged either by the quantity of fluid removed by aspiration or by roentgenogram; moderate if between 300 and 800 cc. were present and large if over 800 cc. was present. Fifty patients were classified as having small hemothorax. Of these, 6 had sufficient aspirations and 44 had insufficient aspirations. There was no significant difference between the duration of fever and the number of days hospitalization between these two groups. Those with sufficient aspirations averaged 2.5 days of fever and 7.3 hospital days. Those having insufficient aspirations averaged 3.9 days of fever and 8 hospital days. The group classified as having had sufficient aspirations was so small, however, that no conclusions could accurately be drawn from this series. Thirty-nine patients were classified as having moderate hemothorax. Of these, seventeen had sufficient aspirations and twenty-two had insufficient aspirations. Those classed as having sufficient aspirations averaged 2.1 days of fever and 5.2 hospital days. Those having insufficient or no aspirations averaged 8.6 days of fever and 18.9 hospital days. These findings suggest that early and frequent aspirations were of benefit in this type of hemothorax.

Sixty-five patients were classified as having large hemothorax. Of these, twenty-eight had sufficient aspirations and averaged 5.5 days of fever and 11.8 hospital days. Thirty-seven had insufficient or no aspirations and averaged 14.2 days of fever and 24.2 hospital days. This suggests that early and sufficient aspirations are beneficial in large hemothoraces.

The records of seventeen patients did not contain sufficient data for classification into any of these groups.

Decortication for empyema or fibrothorax was required in one (2 per cent) of the forty-five patients classed as having sufficient aspirations and six (5 per cent) of the 103 patients classed

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as having insufficient aspirations. Early thoracotomy was required in four instances for massive hemorrhage, one for perforation of the esophagus, two for cardiac tamponade and four for thoracicoabdominal wounds without a fatality.

There were ninety-seven stab wounds, fifteen of which involved both the thoracic and abdominal cavities, and thirty-seven gunshot wounds, seven of which involved both the thoracic and abdominal cavities.

There was a total of twenty-six deaths (15.7 per cent). Eighteen of the patients lived less than twenty-four hours after admission and eight lived less than eight hours following admission, with an average of two hours and thirty-nine minutes. The mortality of those living more than twenty-four hours was 4.9 per cent.

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PILONIDAL CYSTS*

THEIR ORIGIN AND TREATMENT

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IN a series of ninety consecutive patients with pilonidal cysts and sinuses who were treated surgically it was shown that primary closure is the method of choice in treatment. This approximately divides in half the time lost from work when the lesion is treated with some other surgical method. Choice of method of primary closure has little to do with excellence of results whereas meticulous surgical technic has a great influence on results. There are twice as many extensions of the sinus to the left as to the right of the midline. The origin of the sinus and a rational explanation of recurrences is presented based on Kooistra's theory of etiology. It has been demonstrated that when treated with primary closure the recurrence rate should be below 10 per cent and that an important factor in recurrence is the size of the defect that remains after excision of the lesion; the width of the defect is of particular importance. The latter conclusion has not been reported before in the literature.

* * * *

The cases that have recurrences or complications are on the average 20 per cent wider than those that heal without complication. Putting it on another basis, it is shown that those defects which are over 4.2 cm. in width are twice as likely to have complications as those under this size. Choice of method of primary closure, tricks of surgery or fetishes of postoperative care have little to do with the excellence of results. There is no magic highroad to success in treatment of this lesion. Good results are the reward of meticulous surgical technic following principles laid down by Halsted many years ago. Those principles are sharp, gentle, atraumatic surgery; accurate complete hemostasis; use of the finest suture commensurate with tissue strength; no wound tension or pressure and meticulous approximation of wound and skin edges.

The series upon which these conclusions are based was done with two methods of primary closure. The first was by closure in the midline after undermining the skin and subcutaneous tissue to allow closure without tension and the second was by means of a sliding graft from either or both buttocks to give the relaxation necessary for primary closure without tension. Postoperative care was designed to keep the wound clean, dry, and pressure and tension free. Results are indicated in the following table:

TABLE 1

	Closure with Graft	Midline Closure	Total
No. of cases	25	65	90
Total hospital days	873	1,668	2,541
Average days per case	34.9	25.5	28.2
No. of recurrences	3 (12%)	5 (7.7%)	8 (8.8%)
No. of complications	6 (24%)	6 (9.2%)	12 (14%)
Average size of defect after excision of sinus	8.32 by 5.20 by 3.70 cm.	8.61 by 4.28 by 3.24 cm.	
Average size of defect in recurrence or complications	8.62 by 5.62 by 3.65 cm.	9.45 by 5.00 by 3.60 cm.	

A recurrence was any lesion draining after healing was once complete or any lesion that did not heal completely prior to discharge from the hospital. A complication was any lesion, other than a recurrence, which delayed healing or required additional treatment after surgery, for example, hematoma, infection. We found that recurrences usually came while the patient was still in the hospital and very rarely were the first indications delayed until the third month.

Analysis of our statistics gave the following items of information: (1) There are twice as many extensions of the sinus to the left as to the right. (2) The ratio between grafted repairs and midline repairs as to recurrences is 5:3 and

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considering complications is 3:1. (3) The average size of the midline closure that heals without trouble is shorter by 12 per cent and narrower by 20 per cent than those that give trouble. (4) In midline closures the combined recurrence and complication rate is 13 per cent if the fault is narrower than 4.2 cm. and is 30 per cent if the fault after excision is wider than 4.2 cm. (5) The average grafted case was 20 per cent wider and 15 per cent deeper than the average midline closure. The latter fact, rather than the faults of the method, may explain the greater rate of recurrence and complication when this method was used.

The origin of pilonidal cysts is a matter about which there is some disagreement. In 1887 Tourneaux and Herrman said that pieces of the invaginating neurogenic plate broke off and made these cysts. In 1924 Bookman offered a very similar theory. Fox, in the late twenties, differed from the earlier theorists in saying that the cysts were not neurogenic or enteric in origin but that faults in the process of hair and gland development gave rise to the cysts. He also suggested that there might be a phylogenetic relationship between pilonidal cysts and the scent gland in the sacrococcygeal region of birds and amniotes. The pituitary gland has been accused as an accomplice in this disease.

It is this author's opinion that the theory of Kooistra explains observed phenomena connected with this lesion more easily than other postulations. He emphasizes the irregularity of the skin in the natal cleft as being part of the etiologic basis of these cysts. These dimples may be classed as arrests or relicts and result from imperfections in pinching off the neural canal. The dimples contain hair follicles and desquamated epithelium and with trauma and poor hygiene inflammatory changes are noted. Clogging of the opening into the dimple occurs and inflammation in the dimple expands the structure just like a balloon expands when blown up. The blown-up dimple then extends along the path of least resistance subcutaneously and we have mechanically made a sinus that is lined with epithelium. This can well explain recurrences and the fact that recurrences are in the midline in the old scar. If the scar is rough (and it is) and particularly if meticulous closure is not affected, there are man-made dimples in which the process starts all over again. By the same theory the scarcity of the clinical lesion in women is explained by the difference in configuration resulting in better hygiene and less trauma and, therefore, less inflammation.

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CLOSURE OF THE PELVIC FLOOR WITH TANTALUM GAUZE*

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AT the close of the abdominal phase of the abdominoperineal resection for carcinoma of the rectum the operator occasionally experiences great difficulty in closing the peritoneum so as to reconstruct a new pelvic floor. Foresight in fashioning the lateral flaps initially will reduce the occurrence of this predicament, but all operators of experience have encountered it from time to time. In the female pelvis the uterus and adnexa can be pressed into service; in the male it is sometimes possible to mobilize the cecum or to draw the bladder posteriorly. However, if a hiatus is left or if one opens during the early postoperative days, a loop of intestine may readily herniate downward. Having seen a fatal outcome under such circumstances and having nearly lost a patient of his own, the author has employed with success the method shown herewith.

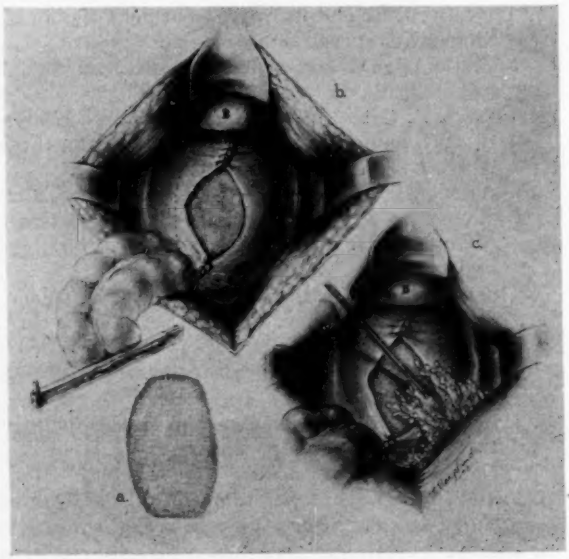

FIG. 1. (*a*) tantalum gauze trimmed and ready for implantation; (*b*) tense peritoneum closed above tantalum gauze; (*c*) bare tantalum being covered with omentum.

* * * *

A section of tantalum gauze mesh such as used by Throckmorton[1] for the repair of hernial defects is trimmed, infolded and fitted to the pelvic inlet. It is then anchored in place with a few sutures and the peritoneum closed above it snugly but not tightly. The bare wire is then covered with omentum, free or attached. In such cases the perineal wound closes promptly and without evidence of foreign body reaction. (Fig. 1.) Doubtless others will wish to avail themselves of this simple and effective method.

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Case Reports

LARGE PARTIALLY CALCIFIED GASTRIC LEIOMYOMA*

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PARTIALLY calcified benign gastric tumors, with ulceration and hemorrhage, are infrequently reported. In view of its rarity and its considerable clinical and pathologic interest a large, partially calcified leiomyoma of the stomach, removed by subtotal gastrectomy, is considered worth recording.

CASE REPORT

A sixty-seven year old housewife was admitted to the Robert Packer Hospital on September 17, 1947, within an hour after having vomited about 2 quarts of material containing bright red blood and undigested food. The patient had been fairly well until the onset of vomiting except for poor appetite for one month. There was no history of previous hematemesis or melena. Over a period of two years the patient had gradually lost about 20 pounds in weight and she had always been troubled with much gas, belching and bloating after meals. There was no history of abdominal pain or jaundice. Bowel movement was regular and the stools were normal. There was no history of alcoholism; past history and systemic review gave no pertinent information.

Physical examination revealed a pale, thin, white female who did not appear to be acutely or chronically ill. Blood pressure was 142 systolic and 88 diastolic, pulse rate 100. Respiration was 32, temperature 99°F., weight 114 pounds. Her head and neck were normal. Her heart was not enlarged and there were no murmurs; rhythm was regular. Coarse rhonchi were heard throughout both lung fields and there were a few moist rales at the right base. The abdomen was flat and showed no scars. A firm, smooth, well defined and non-tender mass which was palpated in the epigastric region moved freely on respiration and extended into the left upper quadrant. The edge of the mass was felt about 8 cm. below the left costal margin.

Laboratory studies revealed the following: hemoglobin 10 gm., red blood cells 3,570,000, hematocrit 36 per cent, white blood cells 7,400, polymorphonuclears 61, lymphs 39, Kahn reaction negative. Urinalysis was normal; cephalin-flocculation test was negative. Total plasma proteins were 7.15 mg. per 100 cc. of blood.

The patient was given a whole blood transfusion and glucose in normal saline intravenously. There was no nausea or vomiting after admission and on the second hospital day she was placed on a first stage modified Sippy regimen. On the third day she received an increased modified ulcer diet. A caffeine gastric analysis showed no free hydrochloric acid.

Fluoroscopy of the stomach revealed a rather extensive calcification in the left upper abdomen. Spot films made at the time of fluoroscopic examination demonstrated extensive scattered areas of calcification encompassing an area approximately 6 or 7 cm. in diameter. (Fig. 1.) A large palpable mass in the epigastrium and left upper abdomen coincided with the position of the calcification.

After administration of the barium meal the esophagus appeared grossly normal. The large mass in the epigastrium was intimately in contact with the lesser curvature of the stomach, apparently displacing the stomach to the left and producing a large defect along the lesser curvature. Films made immediately after administration of the barium meal demonstrated the rather bizarre appearance of the gastric

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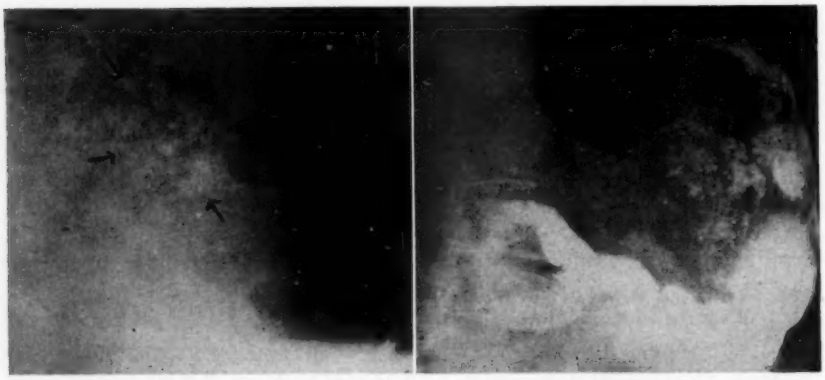

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FIG. 1. Spot film of the abdomen taken during fluoroscopy with the patient in the erect position shows extensive scattered areas of calcification in the left upper abdomen, immediately above the iliac crest.
FIG. 2. Roentgenogram of the stomach taken immediately after ingestion of a barium meal with the patient in the prone position reveals a large deformity along the lesser curvature and scattered calcification in the region of the deformity. An ulcer crater is also seen.

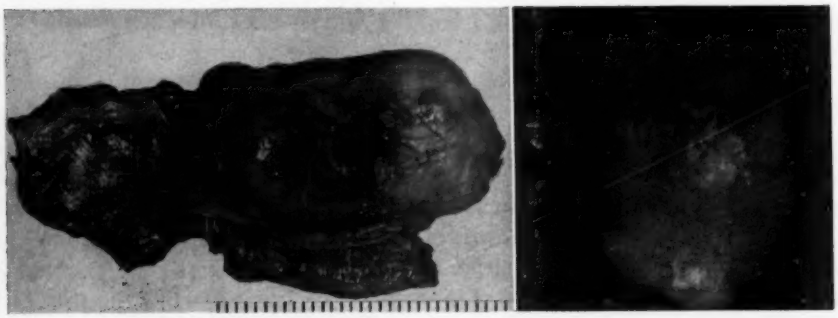

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FIG. 3. Photograph of the large leiomyoma of the stomach. A large ulcer crater is seen on the mucosal surface.
FIG. 4. Roentgenogram of the gastric leiomyoma taken after subtotal gastrectomy showing scattered areas of calcification and dense calcification in the region of the ulcer crater.

deformity as well as the position of the previously described calcification with respect to the deformity of the stomach. (Fig. 2.) No ulcer crater was seen at fluoroscopy but on films an ulcer crater 2.5 cm. in diameter was noted near the central portion of the deformity. The roentgenologist concluded there was a large ulcerated tumor mass containing calcification situated along the lesser curvature of the stomach, the exact nature of which could not be determined by roentgenologic examination alone.

The patient was prepared for surgery with whole blood transfusions and supplemental feeding of concentrated protein and vitamins. Eight days after admission a laparotomy was performed under continuous spinal anesthesia. A large, firm, smooth tumor mass occupied the lesser curvature of the stomach and protruded into the lumen of the stomach. The mass was freely movable and no enlarged lymph nodes were found. The liver appeared normal. The tumor mass was removed by subtotal gastrectomy. The patient was discharged on the twenty-second postoperative day.

The pathologic report revealed the tumor measured 15 cm. by 10 cm. by 7.5 cm. and occupied the submucosal surface of the stomach. (Fig. 3.) In the center of the lesion on the mucosal surface was a large ulcer crater measuring 3.5 cm. by 3.5 cm. by 1.5 cm. Palpation revealed extensive calcification around the ulcer crater and at its base. There was no sign of fresh bleeding. The edges of the ulcer were rolled but did not present the gross appearance of malignancy. On the posterior wall through

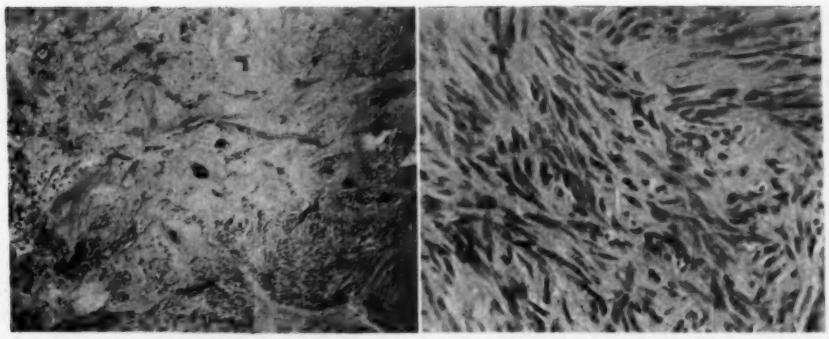

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FIG. 5. Microscopic section of gastric leiomyoma under low power showing small spicules of calcium and hyaline degeneration.
FIG. 6. Microscopic section of gastric leiomyoma under high power shows interlacing groups of spindle-shaped cells with vesicular nuclei; nucleoli are seen; mitotic figures are rare.

the serosal surface a large tumor could be seen which appeared similar to a uterine fibromyoma. Roentgenogram of the tumor after removal revealed patchy calcification throughout the tumor mass. (Fig. 4.) Cut surface of the tumor also revealed extensive calcification.

Microscopic sections of the tumor of the stomach showed interlacing and whorled groups of spindle-shaped cells with vesicular nuclei. (Figs. 5 and 6.) Nucleoli were noted in many of the cells. Cytoplasm extended in long strands from either pole of the nucleus and stained a homologous pink color. Mitotic figures were rare. The tumor was relatively avascular. Scattered throughout were large areas of hyaline degeneration with small spicules of calcium. Two of the sections showed a small portion of intact gastric mucosa at the edge of an area of ulceration. The mucosa showed a chronic inflammatory reaction. The ulcerated area was covered with a thin layer of fibrous exudate. There were scattered foci of lymphocytic infiltration in the tumor beneath the area of ulceration. The histologic appearance suggested a benign stomach tumor, a leiomyoma, which by direct extension had caused ulceration of the gastric mucosa. The hyalinyzed and calcified areas were probably the result of hemorrhage and degenerative changes. The diagnosis was leiomyoma of the stomach with ulceration and calcification.

COMMENTS

Included as benign tumors of the stomach are polyps, fibromas, papillomas, leiomyomas, fibromyomas and adenomas. In three large series of autopsies Dudley and associates, Stewart, and Rigler and Ericksen have reported benign gastric tumors to constitute 22 per cent, 22.8 per cent and 26.2 per cent, respectively, of all gastric tumors. Many of these benign gastric tumors were too small to produce symptoms during life and were possibly too small to be diagnosed by roentgenography.

Benign gastric tumors are rarely found at operation. The incidence of benign gastric tumors found in operative cases of gastric tumors has been reported identically in two large series by Dudley and associates, and by Esterman and Senty to be 1.3 per cent.

In a series of 239 tumors of the stomach or duodenum reported by Rigler and Ericksen approximately 11 per cent were roentgenologically diagnosed as benign.

The differences in incidence of benign tumors described by postmortem examination, roentgenology and operation is due in part to the fact that most benign tumors give few or no symptoms and may not be diagnosed during life. Failure to recognize these cases roentgenologically may also account for this disparity of figures.

Patients with benign gastric tumors who are admitted for treatment usually give a long-standing history of mild gastric distress and in most instances they are hospitalized for severe complications of sudden hemorrhage or pyloric obstruction. In Dudley's series, gastric hemorrhage occurred in 40 per cent of the cases and was the first symptom requiring hospitalization. Pyloric obstruction occurred in about 30 per cent of cases. Blood loss was severe enough to cause shock in about 50 per cent. Gastric analysis is not diagnostic in any instance.

Of the thirty-two benign gastric tumors observed at autopsy in Dudley's series there were two leiomyomas. Rigler and Ericksen found a 2.1 per cent incidence of malignant degeneration in the pathologic examination of forty-five benign tumors of the stomach. Ulceration of the surface of these benign tumors was frequent. Calcification of a benign gastric tumor, illustrated in the case reported here, has not been described as far as we could ascertain and therefore is of clinical and pathologic interest.

SUMMARY

A case of a large, partially calcified leiomyoma of the stomach is described. Gastric hemorrhage was the presenting symptom. Benign gastric tumors are infrequently found at operation. Calcification in a benign gastric tumor appears to be unusual and is interesting.

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K. BOWMAN studied a large group of cases of arthrosis of temporomandibular joints and in twenty of them he removed the disc under local anesthesia, apparently with good results. In thirty-eight other cases the disc was removed under general narcosis. These patients often complain of headache and vertigo which might be due to malfunction of the eustachian tubes. The most common cause of temporomandibular arthrosis is malocclusion of the patient's teeth. Locally, the patients have limitation of the joint movements plus a snapping sensation or crepitation directly over the affected joint. Microscopically, the disc presented perforations and/or nodular deformities, brownish discoloration and often marked degenerative changes. (*Richard A. Leonardo, M.D.*)

LEIOMYOSARCOMA OF STOMACH*

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LEIOMYOSARCOMA of the stomach is not common. In 1946 four cases were reported[1] and the authors stated that they were able to collect an additional ninety-four cases from the literature to that date. It appears worth while, therefore, to place additional cases on record as they appear.

CASE REPORT

C. O. A., a white male of Swedish descent, age fifty-one, was hospitalized on March 29, 1945, with the following history:

For three years the patient had noted occasional recurring lumbar and left costal margin aching pain. It was never severe and never caused the patient much concern. Three months prior to admission the left costal pain had radiated to the left shoulder causing rather severe pain in that part for about an hour; this never recurred.

Two weeks before admission rather typical infectious hepatitis developed and the patient consulted an air force physician who was the first to note a left upper quadrant mass. He called the patient's attention to it.

Past history showed he had had diphtheria in childhood, an appendectomy performed in 1914, hematemesis and tarry stools in 1919 resulting in a negative exploratory celiotomy, malaria in 1924 and 1934, small bladder stone passed spontaneously in 1926, phlebitis of the left leg in 1941 which left a mild recurring edema, coolness and bluish discoloration of the leg, hemorrhoidectomy in 1943, meningitis in 1944, type unknown, treated successfully with some sulfonamide drug and was currently convalescing from infectious hepatitis. His family history was non-contributory.

Physical examination revealed the following significant points: jaundice, slight pallor, moderate emphysema, slight edema and cyanosis of the left thigh and leg with slight calf tenderness on compression and brisk dorsiflexion. In the abdomen there was a long irregular rectus scar in the right upper quadrant with a 5 cm. incisional hernia in its lower portion; there was a McBurney scar in the right lower quadrant which was well healed. The liver descended about 2 cm. on deep inspiration; it was smooth, symmetrical, non-tender, with no nodules. In the left upper quadrant was a visible rounded mass which on palpation was well defined, about 10 cm. in diameter, moved downward freely and definitely on deep inspiration. It was cystic in consistency, non-tender, smooth, readily separated from the left costal margin and region of the spleen, similarly readily separable from the left lobe of the liver. Its upper border passed upward under the medial costal margin making the upper reaches indeterminate.

Laboratory findings were within normal limits except for bile in the urine, an icterus index of 50, an immediate direct Van den Bergh qualitatively and a quantitative Van den Bergh of 4.34 mg.

X-ray examination of the gastrointestinal tract revealed an extragastric mass lying against the greater curvature and encroaching upon the stomach. This mass was below and medial to the spleen and displaced the left end of the transverse colon downward. The transverse colon itself appeared normal. Retrograde pyelography showed moderate bilateral hydronephrosis with the left kidney definitely lying posterior to the mass in the lateral projection.

Diagnosis of the mass was indeterminate. Pancreatic, omental and mesenteric cyst was considered.

Exploratory celiotomy was done April 26, 1945, under continuous spinal anesthesia, through a left upper rectus incision. A large cyst was found 15 by 8 by 7 cm. in size, oval in contour, with many 0.5 to 2.0 cm. firm but not hard, gray, fleshy nodules of tissue in its wall. This cyst lay under and in the gastrocolic ligament and greater omentum, above and anterior to the transverse colon, below and to the left of the stomach, and anterior to the pancreas to which it was not attached. The

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cyst wall was fairly thin in places, perhaps 1 mm. thick, and apparently composed of omentum. Elsewhere the aforementioned nodules composed its wall. On exploring upward it was found that the cyst merged into a solid nodular tumor mass 15 by 8 by 8 cm. in diameter making a total length of 30 cm. This solid mass extended high beneath the diaphragm, pushing a small spleen up and out. The spleen was free from tumor, but on following the greater curvature of the stomach upward it was found that the tumor involved a 3 cm. area of the stomach wall high on the greater curvature, apparently arising from this part of the stomach. The extreme cardiac end of the stomach was free, however. The rest of the stomach, the omentum not immediately adjacent to the cyst, the peritoneum, the left lobe of the liver, the pancreas, the para-aortic nodes and the pelvis were all explored and no evidence of metastases was found. The right lobe of the liver could not be explored adequately because of many old, dense, postoperative adhesions in this area which also obscured the gallbladder. At this stage a tentative diagnosis of leiomyosarcoma of the stomach was made. The cyst was evacuated of about 500 cc. of dark hemorrhagic fluid and a biopsy was done on a piece of the cyst wall. A frozen section was prepared and examined and a diagnosis of sarcoma was made. No tumor cells were found in the centrifuged fluid. The involvement of the gastrocolic ligament and upper portion of the greater omentum and the extent of the mass made it appear desirable to remove the cyst, tumor, portion of the omentum and stomach en bloc which was done, leaving perhaps 10 per cent of the stomach and transecting it about 3 or 4 cm. above the point of any gross involvement by tumor. Grossly, all tumor was removed. An antecolic isoperistaltic termino-lateral type of gastrojejunostomy was done. The patient recovered.

The pathologic report revealed the specimen was a tumor mass; its entire length measured 25 cm. It consisted of a solid and cystic portion. The solid portion was 13 cm. long, 7.5 cm. wide and the thickest part was 6.5 cm. Its external surface was nodular and the nodules varied from 5 to 0.8 cm. in diameter. A part of this solid mass was covered with a piece of great omentum which was firmly adherent to it. This covered area had an extent of 10 cm. by 4 to 5 cm. The omentum contained a small amount of lobulated fat. Elsewhere the solid mass was covered by a very small amount of thread-like fibrinous material. Blood vessels were very prominent on its surface. The mass had a grayish pink color, and its consistency was moderately firm. Section through this solid portion revealed a grayish pink surface and a number of small hemorrhagic areas, with larger and smaller areas consisting of yellowish, friable, well circumscribed material. Translucent jelly-like substance was also present inside but not in great amount. A nodule measuring 2.5 cm. wide was found adherent to the wall of the stomach and protruding into the gastric cavity. A part of this nodule was covered by the gastric mucosa, which was not firmly attached to it, and there were a number of small ulcers seen on this part of the gastric mucosa. This nodule had definitely arisen from the musculature of the wall of the stomach and there was no demarcation between the two, no trace of musculature being found in the mucosa-covered portion. The cut surface of the tumor was moist and there were many hemorrhagic spots of different dimensions at the junction of the solid and cystic portions. At this area there were many cysts containing fresh blood; they varied from 0.3 to 1 or 2 cm. in diameter. The inner surface of these cysts was roughened and covered with blood-stained material.

The cystic portion of the tumor mass measured 12 cm. long and 8 cm. wide. The external surface was also nodular and many prominent blood vessels could be seen. It was also covered by a piece of omentum, which extended through about one-fifth of the external surface and was firmly adherent. The cyst was dark red in color. The size of the external nodules varied from 1 to 5 cm. in diameter. The contents of this cystic portion was a considerable amount of blood-stained fluid. The wall of the cyst was obviously an extension from that of the solid portion, the thickness being between 0.2 to 1 cm. Its consistency was not too tough. The cut surface of the thickest part was grayish pink in color and uniform in appearance. On the whole the inner surface of the cyst was rough and nodular. The end portion of the cyst was thicker than the remaining part as the inner surface here was covered with many larger and smaller friable irregularly shaped masses of tissue. These masses of tissue were easily removed, but they were obviously from the wall. The inner surface of the junction be-

tween the solid portion and the cyst was not as rough, and there appeared to be a lining membrane. The color of this area was dark red. There were some adherent streaks of yellowish material.

A portion of the stomach was attached to the specimen. It measured 20 cm. long and 10 cm. wide. On the whole it presented nothing remarkable, except where the protruding nodule was. The mucosa at this point was broken for a length of 5 cm. and five small ulcers were found, each being about 2 to 4 mm. in diameter. The edge of these ulcers was somewhat irregular, the color dark red. They appeared to be superficial ulcers. The protruded mass was covered with gastric mucosa at this area in which the ulcers were seen.

Sections were taken from the following: the tumor mass covered by gastric mucosa, the junction of the solid and cystic portions, the end portion of the cystic mass in which the friable masses were present, the thinnest part of the cyst and the part covered by omenum. Frozen section made from the wall of the cyst suggested sarcoma of low grade malignancy.

Microscopic examination revealed:

1. The mucous membrane appeared thinner than normal. The glands were less in number. Small areas of broken mucosa were present, but there was nothing else of importance. There was very little submucosa and where present it was composed of very loose fibrous tissue and some thin-walled vessels. There was no more musculature in existence, this having been replaced by tumor tissue. The tumor tissue was composed of whorls and strands of cells, with larger and smaller faintly stained areas. The nuclei of these cells varied in size, but they were mostly oval-shaped. Many of them were deeply stained with hematoxylin. The nucleoli were mostly visible. Mitosis was found with an incidence of one in every one or two high power fields. The cystoplasm was faintly stained. Most of them contained vacuoles of different size. Sections stained with Mallory's stain showed a considerable quantity of fine collagen fibrils scattered among the tumor cells. There were many blood spaces showing indefinite walls. They were filled with well preserved red corpuscles. The faintly stained areas were composed of very loose adult fibrous tissue.

2. The thicker portions showed a similar picture to 1.

3. Practically normal peritoneum was seen, there being no infiltration of tumor cells into the omentum. The tumor tissue was composed of necrotic material. The protruding masses as seen in the gross specimen turned out to be tumor cell masses. The external portion of the cyst wall was covered with a thin layer of dense fibrous tissue and there were no tumor cells found there.

A part of grossly normal stomach wall was taken for sectioning and nothing abnormal was seen. The remaining sections were similar to those already described. The diagnosis was leiomyosarcoma of stomach.

One month after operation a barium swallow was given. The barium passed promptly through the small remaining stomach which was about 6 cm. wide and 7 cm. long.

One year after operation, April 1946, the patient was examined at the Mayo Clinic and the following report was furnished: The patient was having no symptoms but was quite concerned about the possibility of any recurrence. Physical examination revealed a large ventral hernia in the right upper quadrant, moderate emphysema and evidence of undernutrition. Urinalysis, blood counts, routine flocculation test for syphilis and x-rays of the chest were all negative. The x-ray of the stomach showed almost complete gastrectomy with a free and normally functioning anastomosis. There was no evidence of recurrence of the stomach tumor. The pathologist's report on the slide sent in from outside revealed a partially degenerated, grade 1, leiomyosarcoma.

Two years after operation the patient reported that his strength had returned, he had gained 15 pounds since operation and could eat relatively normal amounts at each meal.

COMMENTS

Schindler et al. emphasize the following points concerning leiomyosarcoma of the stomach: While rare, it is probably more common than supposed. Schindler saw four cases between 1940 and 1944. This writer saw a case in 1940, the one reported herein being the second one he has seen. Comments of other surgeons would lead one to think that leiomyosarcoma is seen from time to time. The prognosis, as compared to gastric cancer, is good. Metastases frequently will not form for a long time, but there is a tendency to expansive growth as illustrated in this case. There are several gross

types, namely, those which grow into the lumen of the stomach and may be pedunculated; those which grow within the gastric wall and the type presented herein which expands into the omentum and neighboring structures. Cyst formation, however, is not mentioned by Schindler et al. This probably is comparable to the hemorrhagic cysts which may occur in uterine leiomyomas. The patient's severe pain three months prior to admission, which radiated to the left shoulder, may have been due to hemorrhage which formed the basis of the cyst found.

Three cardinal findings are said to be gastrointestinal hemorrhage leading to anemia, epigastric or left upper quadrant pain and upper abdominal mass. This patient definitely presented the latter two features. Is it remotely possible that the hematemesis and melena twenty-six years previously arose from a then benign leiomyoma which, lying high on the greater curvature, might have been overlooked at operation?

X-ray findings are rather characteristic. "The x-ray syndrome of filling defect, plus central niche, plus fistulas, should be considered as highly suggestive of leiomyosarcoma."[1] This, coupled with gastroscopy, lead Schindler et al. to state that the "preoperative diagnosis of leiomyosarcoma of the stomach is in the realm of possibility."

SUMMARY

A case of leiomyosarcoma of the stomach is presented and some pertinent points briefly reviewed.

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TREATMENT OF OBSTRUCTION OF THE AQUEDUCT WITH AN INDWELLING RUBBER CATHETER*

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TORKILDSEN'S operation,[1] in which a rubber catheter is passed from one lateral ventricle through an occipital burr opening and then down under the skin to the cisterna magna to bypass aqueduct obstruction, has proved to be a useful palliative procedure. White,[2] Penfield[3] and others have confirmed his work. The author has used this operation successfully in five cases. Histologic studies[4] would indicate that the brain tissue tolerates the adjacent catheter with little reaction. Insertion of a rubber catheter in the aqueduct when there is moderate external pressure or obstruction by delicate glial tissue often is easy; and if the aqueduct will tolerate the adjacent rubber tissue as well as cerebral tissue, it would be an easier procedure than the Torkildsen operation.

According to reports in the literature, several attempts have been made to leave a catheter in the aqueduct, but lack of success seems to have kept others from attempting this procedure. Dandy in 1920[5] reported two cases in which a large rubber catheter was inserted in the aqueduct to relieve infant hydrocephalus. The first patient did not survive; in the second case reaction necessitated removal of the tube. Rivarola[6] described a similar experience. In 1944 the author reported a case[7] in which a catheter in the aqueduct was tolerated over a long period of time. I wish to review this case giving additional follow-up data, and, in addition, report two more cases, of which one patient is living and well eighteen months after insertion of the catheter; in the other case insertion of the catheter was inadvisable because of reflex respiratory cessation.

CASE REPORTS

CASE 1. Mrs. A. H. B., a white woman aged fifty-two, was first examined November 10, 1941. Her family stated that she had had headache and double vision for five weeks and had been confused and rambled in her speech. There was complete paralysis of upward gaze and some internal strabismus of the right eye. Examination of the fundi showed a choked disc of two diopters with hemorrhage on the right. There was marked ataxia of the trunk muscles so that she had difficulty in rising to a sitting position and had a tendency to fall backward (superior cerebellar lesion). She was unable to walk or stand without support and there was marked stupor and disorientation.

A ventriculogram on November 14, 1941, revealed a dilated ventricular system but no filling of the fourth ventricle. Because of doubt as to whether the tumor lay primarily in the pineal region or in the superior cerebellum, an unusual bone flap was turned down, including not only the suboccipital region but also a considerable area above the tentorium. The dura was first opened above the tentorium near the midline on the right side, and after coagulating several large veins the right occipital lobe was retracted to give a view of the corpus callosum. This appeared to be perfectly normal, not bulging, and was not incised. The dura was then opened below the transverse sinus. The superior cerebellum was easily seen and also appeared to be negative. The fourth ventricle was then opened and a small catheter (No. 10) was passed upward into the aqueduct. It was ascertained that there was a definite obstruction about ½ inch above the fourth ventricle. The upper part of the vermis was then divided, including a portion of the anterior medullary velum and lower portion of the aqueduct, until the point of block actually could be seen. A small bayonet forceps introduced at this point allowed fluid to escape from the ventricles above, but removal of the forceps was followed by return of the obstruction. The catheter was easily passed on upward beyond this point into the third ventricle. Saline solution introduced into the lateral ventricle escaped through the catheter, which was then divided at a point so that its tip lay well below the foramen magnum in the

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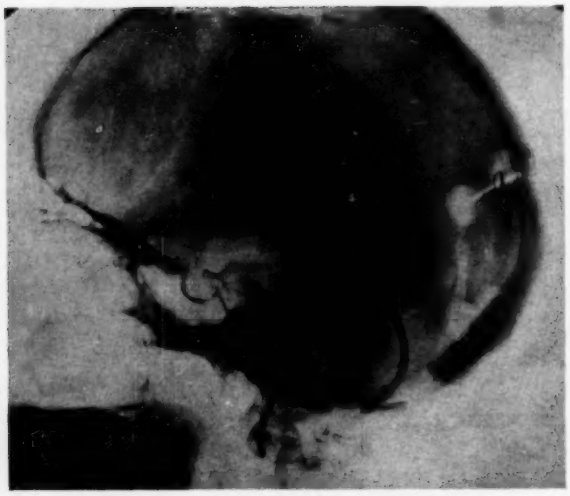


FIG. 1. Case 1. X-ray showing rubber catheter in aqueduct of Sylvius.

spinal subarachnoid space. The arachnoid was closed over it with two fine silk sutures and the tube was anchored to the dura with a double suture of silk.

The procedure seemed to be well tolerated by the patient except for a postoperative rise in temperature to 103°F. which lasted less than twenty-four hours. She improved from the beginning and was discharged on the seventeenth postoperative day. It was noted at this time that most of the papilledema had subsided. Six weeks after operation she was clear mentally and the optic nerves were normal. She was able to walk with help. She did not complain of headache. It was noted that the right eye could be turned slightly upward but not the left. There was still some weakness of the right lateral rectus.

This patient was not seen again but letters were received at intervals. She did fairly well for about a year although she was never able to walk entirely alone. The last letter, written by her husband in September, 1943, stated that her vision was poor, that she had lost considerable weight and had little appetite. Although her family was advised to bring her back for additional surgery, this was not done. We heard indirectly that she died several months later. The exact date of her death is not known but it was slightly over two years from the time of surgery. Whether her death was caused by reaction to the catheter or by a tumor undisclosed by operation was not known. (Fig. 1.)

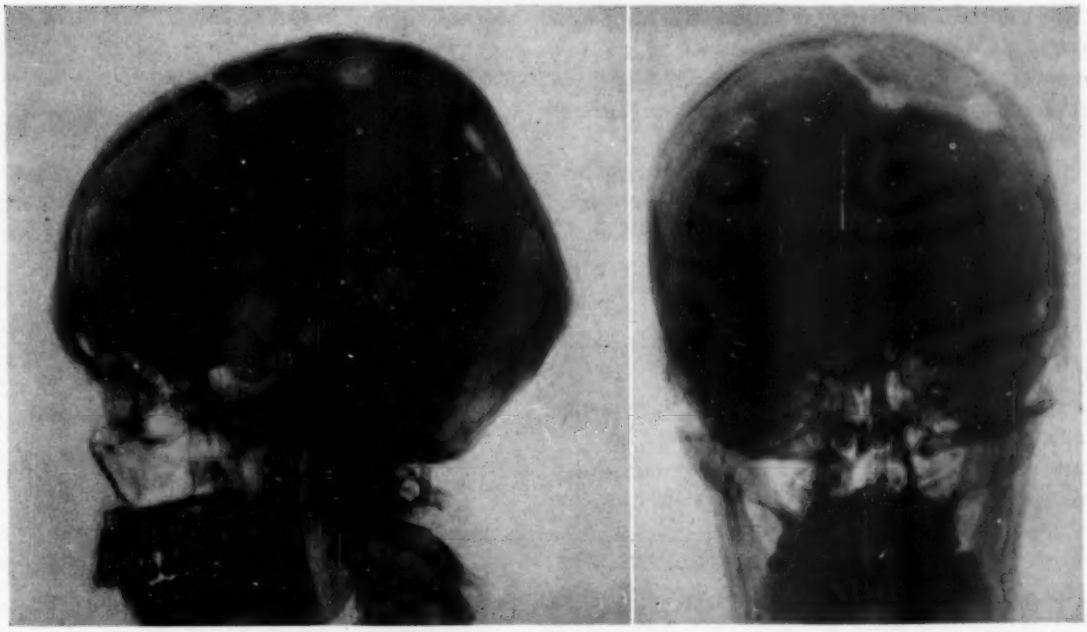
CASE II. B. P. M., a white man aged thirty-five, was admitted to the Methodist Hospital on January 12, 1946, complaining of severe headache which had begun approximately five months before. More recently he had been stuporous and had some difficulty in keeping his balance when he walked. There was some vomiting and pain in the neck but the remainder of the history was essentially negative.

Neurologic examination showed the pupils to be sluggish to light, and there was bilateral papilledema, with hemorrhages on the right disc. The visual fields were full and the remainder of the cranial nerves were normal. There was definite nuchal rigidity. There were no reflex changes except absent biceps and triceps reflexes on the right. A ventriculogram on January 14, 1946, showed marked dilatation of the lateral and third ventricles, and a large, well filled fifth ventricle in the cavity of the septum pellucidum. No gas was demonstrated in the aqueduct or fourth ventricle.

Due to the fact that the fifth ventricle was well filled with gas, it was thought that this was not the cause of his increased intracranial pressure. An exploration of the posterior fossa was done on January 15, 1946. A midline approach was used with removal of bone in the occipital region. After ligation of the occipital sinus and opening the dura, both hemispheres were explored with a cannula since they seemed to be slightly bulging. The vermis was then divided and the fourth ventricle opened high enough to see the aqueduct. A No. 12 catheter was passed through the aqueduct into the third ventricle against very definite resistance. Fluid flowed freely from the catheter, but upon its withdrawal the aqueduct again was obstructed. The catheter then was reintroduced and cut off to such a length that its lower end lay well down in the cisterna magna. It was fastened to the dura with a silk suture.

This patient did not do well postoperatively. His stupor continued; and although he did not complain of headaches, he showed considerable languor and lack of appetite. It was believed that although the fifth ventricle filled there might still be blockage of the ventricular system through valve action.

On February 5, 1946, a small parasagittal osteoplastic flap was turned down on the right, slightly posterior to the motor area, and the posterior part of the corpus callosum was incised. The fifth ventricle was immediately entered. It was noted that there was a large opening in the left side of the septum pellucidum. The left ventricle was examined with



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FIGS. 2 and 3. Case II.

lighted retractor and the right side of the septum pellucidum was opened to explore the right lateral ventricle. There seemed to be an abnormal bulging in the superior surface of the posterior part of the third ventricle. This was tapped with a needle and bloody fluid obtained. However, no biopsy was taken.

Because of the evidence of tumor in the roof of the third ventricle, the patient was given a course of x-ray therapy consisting of a total of 3,000 r units to each of two lateral fields crossfiring the region of the cerebral aqueduct. He seemed to improve under x-ray therapy and was discharged from the hospital March 11, 1946. Figures 2 and 3 show the position of the catheter.

He returned on May 21, 1946, at which time he seemed to be doing fairly well although he staggered considerably when he walked. There was no headache and the optic nerves were normal. He was perfectly alert and clear mentally. There was slight weakness of the right hand.

He was last seen on July 16, 1947, eighteen months postoperatively, at which time he was walking perfectly except for slight unsteadiness. He stated that he was ready to return to work and was given permission to do so.

CASE III. Miss J. F., an obese white girl aged sixteen, was admitted to Methodist Hospital on March 15, 1944. She complained of severe suboccipital and frontal headaches present for one month. The onset was sudden and accompanied with nausea and vomiting. There was dimness of vision; she was drowsy and inclined to sleep most of the time. Neurologically, there was advanced papilledema, with bilateral hemorrhages, but except for these findings the neurologic examination was negative.

X-rays of the skull showed an irregular pituitary fossa, with some erosion of the dorsum sellae. A ventriculogram on March 17, 1944, showed marked dilatation of the lateral and third ventricles, but no gas in the fourth ventricle. A small, rounded tumor appeared to protrude from the posterior part of the floor of the third ventricle. The aqueduct was not seen in any view.

On the same day a midline suboccipital craniectomy was performed and the vermis divided to explore the fourth ventricle. A catheter was passed through the aqueduct into the third ventricle with only slight resistance, and fluid then escaped from the previously obstructed aqueduct. Within a few seconds the patient stopped breathing and the catheter was withdrawn. Reinsertion again seemed to cause breathing to stop. For this reason the catheter was removed and the Torkildsen procedure employed.

This patient also was subjected to postoperative radiation and the condition rapidly cleared up. She was able to leave the hospital

on the eighteenth postoperative day and was able to be up and about one week after leaving the hospital. When last seen October 11, 1946, thirty-one months after operation, she had no symptoms except moderate obesity.

This case is included because of the respiratory embarrassment which seemed to contraindicate use of the catheter in the aqueduct.

COMMENTS

No postmortem material has been available to determine how much reaction occurs in the tissues around the aqueduct, but it would appear that this is minimal in view of the survival of one patient for two years and the excellent condition of the second patient eighteen months after insertion of the catheter in the aqueduct. Whether the death of the first patient was caused by reaction to the catheter or an undisclosed tumor can only be surmised. Certainly the two cases show that the procedure is a feasible palliative measure, similar to the Torkildsen operation and is somewhat easier to do since it does not involve any more surgery than the usual suboccipital craniectomy. Additional histologic information is needed as to the exact reaction of the tissues surrounding the aqueduct to the indwelling rubber catheter.

There is no doubt about the presence of obstruction in these two cases and relief of the obstruction by the described procedure. The fact that the nature of the lesion in each case, whether tumor or cicatrix, has not been positively established should not materially affect the value of the case studies.

SUMMARY AND CONCLUSION

Two cases have been reported in which an indwelling catheter was placed in the aqueduct to relieve obstruction. In both cases there was success in relieving the block. The first patient was relieved and lived for a period of over two years. The second patient was in good health eighteen months postoperatively.

A third case is reported in which an attempt to insert the catheter in the aqueduct resulted in reflex cessation of respiration necessitating the substitution of Torkildsen's procedure to bypass the point of block.

It is believed that the insertion of an indwelling rubber catheter in the aqueduct is a sound palliative procedure.*

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* Subsequent follow-ups show the patient in Case II to be alive, well and employed part-time four years after surgery. The patient in Case III is still alive and has no symptoms. In an additional case postmortem sections in the region of the aqueduct four months after the insertion of a catheter showed no reaction in the periaqueductal tissues. This was a case of metastatic carcinoma high in the cerebellum in which a catheter served to keep the aqueduct open for this period of time.